APPENDIX A

Distribution List

Seattle Campus Master Plan Final EIS Distribution List

	Name
PUBLICATIONS	**Seattle Times**
	Daily Journal of Commerce
	The Daily
	UW Today
AGENCIES	SEPA Public Info Center City of Seattle Dept. of Construction & Inspections
	University Neighborhood Service Center
	SEPA Center Dept. of Natural Resources
	Dept. of Ecology SEPA Unit Environmental Review Section
	Harold Scoggins Fire Chief Seattle Fire Department
	Office of EPA Environmental Protection Agency
	Patty Hayes Director Seattle & King County-Public Health
	Environmental & Safety Division Seattle City Light
	James Irish Environmental Manager Sound Transit Link
	Lindsay King Dept. of Construction & Inspection
	Director Seattle Dept. of Transportation
	Seattle Police Department
	Seattle Dept. of Parks and Recreation

Seattle Campus Master Plan Final EIS Distribution List

	Name
	SEPA Coordinator Seattle Public Utilites
	Russell Holter Project Complience Reviewer Dept. of Archeology & Historic Preservation
	Executive Director Puget Sound Clean Air Agency
	Isabel Tinoco Fisheries Director Muckelshoot Tribe
COMMUNITY ORGANIZATIONS	Eastlake Community Council
	Laurelhurst Community Club
	Montlake Communtiy Club
	Northeast District Council
	Ravenna Bryant Community Association c/o Ravenna-Eckstein Community Center
	Roosevelt Neighbors' Alliance
	View Ridge Community Club
	Wallingford Community Council
	President Wedgewood Community Council
	Matthew Fox c/o University District Community Council
	Alternate University District Community Council
	Roosevelt Neighborhood Association
	University Neighborhood Service Center
	The U District Partnership
	Greater University Chamber of Commerce

Seattle Campus Master Plan Final EIS Distribution List

	Name
	President Portage Bay/Roanoke Park Community Council
LIBRARIES	Montlake Branch Seattle Public Library
	University Branch Seattle Public Library
	Documents Department - Central Library Seattle Public Library
	UW Health Sciences Library
	Shingeko Podgorny Reference Division UW Suzzallo Library
	Carla Rickerson NW Collection UW Suzzallo Library
CUCAC	Yvonne Sanchez Eastlake Community Council
	Doug Cambell University District Partnership
	Kay Kelly Laurelhurst Community Club
	Tamitha Blake Montlake Community Club
	John Gaines Portage Bay Roanoke Park Community Council
	Joan Kelday Ravenna Springs Community Group
	Brett Frosaker Ravenna-Bryant Community Association
	Eric Larson Roosevelt Neighbors Alliance
	Scott Cooper Roosevelt Neighborhood Association
	Barbara Quinn University Park Community Club

	Name
	Brian O'Sullivan Wallingford Community Council
	Kerry Kahl UW at Large Rep
	Ashley Emery UW Faculty Senate Rep
	Chris Leman Eastlake Community Council
	Louise Little University District Partnership
	Leslie Wright Laurelhurst Community Club
	Barbara Krieger Portage Bay Roanoke
	Pamela Clark Ravenna Springs Community Group
	Jorgen Bader Ravenna-Bryant Community Association
	Ruedi Risler University Park Community Club
	Jon Berkedal Wallingford Community Council
	Osman Salahuddin UW Student Rep
	Rick Mohler UW Faculty Senate Rep
	Maureen Sheehan City of Seattle, DON
	Karen Ko City of Seattle, DON
	Julie Blakeslee UW Environmental Planner
	Elizabeth McCoury University District Partnership
	Jeannie Hale Laurelhurst Community Club

	Name
	Bryan Haworth Montlake Community Club
	Inga Manskopf Ravenna-Bryant Community Group
	Matt Hoehnen Roosevelt Neighbor's Alliance
	Dirk Farrell Roosevelt Neighborhood Association
	Matt Fox University District Council
	Miranda Berner Wallingford Community Council
	Alternate

In addition to the distribution list above, a postcard notification by US Mail was sent to every address within the Primary Impact Area as defined in this EIS.

UW Seattle Campus Master Plan Final EIS Distribution List

Association of King County Historical Organizations
Bader, Jorgen
Colman, McCune
Community Transit
CUCAC
Washington State Department of Archaeology and Historic Preservation
Docomomo WEWA
Feet First
Feet First, Cascade Bicycle Club and Transportation
Choices Coalition
Hart, Karen - SEIU Local 925
Historic Seattle
Cohen, Jennifer – UW Athletics Department
Eglick, Peter - Jensen Motorboat
Fran, Joseph Mary & Stanislaus, Mike
King County DOT
Laurelhurst Community Club
Livable U District Coalition
Muckleshoot Indian Tribe
Nixon, Shirley
Ravenna Bryant
Seattle DOT
Seattle DCI
Seattle Displacement Coalition
Smoot, Jeffrey
Sound Transit
U District Alliance for Equity and Livability
UAW Local 4121
University District Community
University Park Community Club
UW Department of Biology
UW Professional Staff Organization
UW Department of Psychology
UW Recreational Sports Programs
Volkman, Kevin
Ward, David
Wilkins, Steve
City of Seattle DCI
Seattle Urban Forestry Commission

Ashworth, Justin
Bader, Jorgen
Baratuci, Bill
Bartlett, Erika
Bennett, John

Best, Brooke
Bollinger, Daniel
Branch, Trevor
Bressler, Ryan
Brod, Brooke
Clare, Joe
Coney, Russel
Crocker, Cory
Dailey, David
Doherty, Theresa
Eames, Karen
Eckard, Sterling
Enright, Brennan
Ersfeld, Lucia
Finlayson, Bruce
Fitzpatrick, Sean
Fluharty, David
Foltz, Mark
Fox, John
Fucoloro, Tom
Ganter, Tyler
Genereux, Garrett
Gibbs, Cynthia
Grubbs, Kathryn
Gustafson, Joshua
Harnett, Erika
Harniss, Mark
Harris, Kameron
Hatch-Ono, Ann
Hays, Matt
Helt, Mike
Howard, Nick
Hubbell, Nathan
Jarvi, Jessica
Jiambalvo, James
Johnson, Adam
Joseph, Mary
Kalinoski, Hannah
Knapp, Curtis
Krannick, John
Lane, Trevor
Le, Nam
Leake, Mike
Lieberman, Nicole
Linda
Longino, August

Lowy, Josh
Machida, N
Majeski, Stephen
Manning, Joe
Martin, Hans
Martinez, Rene
Marvet, Claire
Maslenikov, Katherine
Matthaei, Christie
Matthaei, Dianne
Matthaei, Fredrick
Matthaei, Jake
Matthaei, James
Matthaei, Marcia
Matthaei, Richard
McGarrah, Carli
McGarrah, Eric
Merriman, Sarah
Miller, Don
Moinzadeh, Pardis
Moore, George
Morison, David
Neff, Peter
Nelson, John
Nguyen, Hai
Nichols, Ann
Nielsen, Thomas
Nixon, Shirley
Olson, Aaron
O'Neil, John
Pai, Jordan
Palunas, Kovas
Parker, Kiana
Peek, Alex
Perkins, Alexandra
Perlot, Rachel
Poalgye, Brian
Price, Dylan
Prince, Kevin
Reynolds, Dylan
Sadilek, Martin
Saxby, Chris
Sbragia, Jack
Scharffenberger, William
Schmitt, Jeffrey
Seattle Audobon
Serebin, Hester

Smoot, Jeff
Stjepanovic, Sacha
Sullivan, Woodruff
Taylor, Maxwell
Thompson, Skyler
Tichenor, Lance
Tickman, Benjamin
Tokuda, Emi
Tooley, Wes
Treffers, Steven
Turnquist, Reba
UW IMA
Vogt, Jenna
Waldo, Nick
Wall, Valerie
Walton, Stephanie
Waterman, Amy
Welch, August
Whang, Linda
Wilcock, William
Wilkins, Steve
Wright, Yugala Priti
Yantis, Susan
Yim, Gibbs
Zhou, Weibin
Climbing Rock Petition
Sharp, Emily
Bader, Jorgen
Lukaszek, Paula
Bernier, Annette
Hart, Karen
Saenz, Lindsay
Gift, Victoria
Balinski, Matt
Johnson, Rhonda
Vitullo, Peggy
McDowell, Scott
Wahl, Eric
Sullivan, Woody
Hodges, Bob
West, David
Forbush, Dom
Ellison, Richard
Leigh, Steve
Colvin, Casey
Ono, Amy
Schaefer, Thomas

Clarke, Vicky
Pasciuto, Giulia
Lawlor, Abby
Bright, Dale
Nixon, Shirley
Ding, Rona
Crocker, Cory
Matthaei, James
McMurrer, Anya
Williams, Sean
Broner, Alex

APPENDIX B

University of Washington Urban Forestry Management Plan

Office of the University Architect / 2016

URBAN FOREST MANAGEMENT PLAN

Purpose of Plan

VISUALIZING | ANALYSIS | VISIONING | PLANNING

The University of Washington takes pride in the quality of the natural environment of this region and on campus, illustrated by the landscape's complex and diverse character. To preserve its beauty and function, the University actively plans and develops strategies for protecting it in the face of new development. The Urban Forest Management Plan helps align various planning studies with the conservation and enhancement of the University's Urban Forest. The following goals provide the framework that becomes the lense by which strategies are developed through a thoughtful analysis of the tree canopy and resources.

Effectively **communicate the value** of UW's urban forest canopy relative to diversity of species, air quality, storm water, and well-being for humans and wildlife. Identify benefits/deficits associated with increasing/decreasing our urban forest on campus balanced with open space needs and access to daylight. Establish metrics for measuring and monitoring this over time.

Identify **canopy coverage goals** to include percent cover per campus district and species selection criteria. Establish tree planting locations for large and small scale plantings; formal and informal plantings; memorial tree locations; naturalized and habitat enhancing locations; replacement plantings; and general guidelines for selecting plantings locations.

Identify opportunities to **become better stewards** of the urban forest through best management practices for protecting, planting, transplanting, wood reuse, and maintaining the trees on campus during establishment and long-term care. Provide policy recommendations for the protection of trees to include definitions for designation, replacement standards, approval process for removal, development of a replacement fund, and recreational use of trees (slack lines, hammocks, etc.). Identify dedicated and potential funding sources for the ongoing management of the urban forest and upkeep of this document.

Increase general knowledge and awareness of the urban forest through the development of campus tree tours, walking maps, informative posters, and a campus tree calendar; access to an online campus tree database; establishing annual tree planting work parties including Tree Campus USA and Arbor Day celebrations; and working with students to develop capstone projects and faculty to identify resources to enhance teaching.

Maintain a **current and dynamic tree database** for all trees on campus with information related to tree species, size, health, value, maintenance records, etc. Increase safety on campus by identifying and removing high risk trees and tree parts. Identify concerns related to trees with a high level of wind or disease susceptibility, high risk areas based on adjacent use, and risk relative to past maintenance activities.

Implement management strategies that are acknowledged, understood, and accepted by relevant municipal departments as regulated under the 2018 Campus Master Plan. Coordinate with the City of Seattle to identify exceptions to the codes administered by DPD regarding regulations around tree protection, removal, replacement and permitting to separate tree removal from building permit applications.

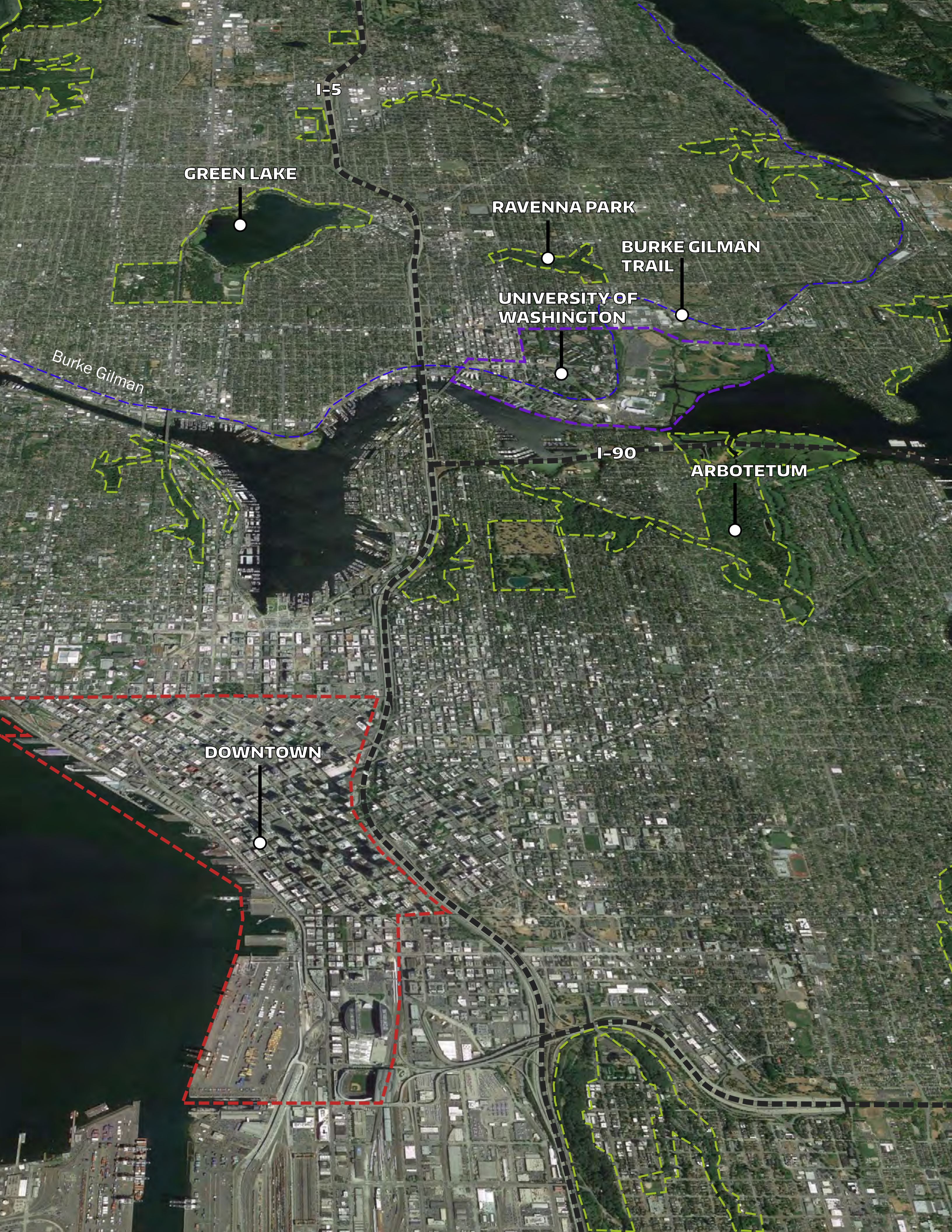

I-5
GREEN LAKE
RAVENNA PARK
BURKE GILMAN
TRAIL
UNIVERSITY OF
WASHINGTON
Burke Gilman
I-90
ARBOTETUM
DOWNTOWN

TABLE OF CONTENTS

1

Intro to Urban Forestry

The clearest way into the Universe is through a forest wilderness

John Muir

The majestic views of mountains and trees in both the foreground and background gives Western Washington its iconic landscape vistas. The landscape's historic condition has been substantially disturbed by man-made and natural forces, leaving us with relics of its old-growth character. The history of the Northwest forest is built on narratives of different management strategies, each signifying changes in development, man's vision and our understanding of the forest. Today, we are required to develop policies and management strategies that support the reestablishment, enhacement, and protection of the urban forests that remain. As the pressure of development continues in Seattle and on campus, balancing open space with buildings is pivotal for maintaining the natural experience in the city and on campus. The city of Seattle has established a standard for properly managing the Urban Forest through a sustainable framework that considers ecological, management, and stewardship goals as overlapping pillars for maintaining a healthy and vibrant urban forest. The University shares the same values as the city and is working towards addressing the challenges and opportunities associated with improving the installation, maintaince, and monitoring of the urban forest.

Washington's Forestry Past

LOGGING | MILLING | SKIDROW | HOUSING

The dense stands of Douglas fir, hemlock, spruce and cedar have been a symbol of the Puget Sound region since it was first inhabited. Historically, the dense canopy of trees were actively managed by local Native American tribes for food, clothing, ceremonies, and housing. Since then, the vision for our forests has shifted towards increase harvesting and manipulation. The history of this resource can be divided into four periods of significance, each representing a different ideology of how to sustain their production into the future.

PRE-SETTLERS : before 1848

Prior to European settlement, local Native Americans harvested and managed the forest in-line with the natural ecology. Some archaeologist believe that this region was one of the first populated areas in North American. They used the forest sustainably for weapons, baskets, and mats, with red cedar being specifically used to construct homes and canoes. As a management tool, they conducted annual burns to increase berry production and to encourage the growth of food crops. There are accounts of explorers writing about first arriving to an "impenetrable wilderness of lofty trees." In 1828, the Hudson's Bay Company (HBC) expanded their economic efforts beyond the fur trade by building a lumber mill at Fort Vancouver, dramatically transforming how we used and valued the forest of the Northwest; from hunter-gathers to manufacturers.

THE RISE OF THE LUMBER INDUSTRY : 1848 - 1883

The gold rush of 1848 sparked a growing demand for lumber used for steam powered engines and as structural supports within mining tunnels. In addition, lumber was increasingly being harvested to build housing and shops in burgeoning mining towns and lumber camps. By the mid-1850's there were over 100 mills in the Puget Sound region, run by lumber barons who saw this region's forests as an inexhaustible resource. This period also saw an increase in illegal logging and timber theft along with high levels of corruption within the industry.

TECHNOLOGY, RAILROADS, AND CAPITAL : 1883 - 1940

The expansion of the railroad throughout this region and beyond provided greater access to harvestable land along with expanding timber markets across the country. This paired with advancements in logging technology resulted in dramatic increases in lumber production. This period also marked the beginning of government intervention through policy developed to limit loggings' negative impact on watersheds. As part of this thinking, the first head of the Forest Service, Gifford Pinchot felt that old-growth forests were wasteful because they grew very slowly. This encouraged the harvesting of old growth forests to be replaced by a younger faster growing stands for production purposes. Wars along with the Great Depression caused the lumber industry to be in constant flux during this period. From 1905 to 1930, Washington was the nation's leader in timber production until Oregon took over the title in 1931.

INTENSIVE LOGGING, ENVIRONMENTALISM, AND OWLS : after 1940

The lumber industry lost its dominance in Washington's economy during WWII. Most of the harvested lumber after the war went towards pulp and paper due to a change in demand. The lumber Industry continued to grow steadily, while other industries like airplanes, atomic weapons, and other goods grew much faster. Timber prices rose substantially as the private supply of trees declined. The Forest Service emphasized rapid logging and intensive management. They were optimistic that the high levels of production could be sustained as technology and scientific expertise would circumvent depletion.

source: National Archives and Records Administration

↑ The US Army Corps of Engineers built the Lake Washington Ship Canal and the Hiram Chittenden Locks to allow passage between fresh water Lake Union and salt water Puget Sound. Photo taken November 25, 1917

↓ Urban Forestry has become a prominent research focus of cities due to their relationship with public health, ecological processes, economic development, and livability.

FORESTRY TODAY: 2015

Today, the Washington State Department of Natural Resources (DNR) and the Forest Service help manage the forest through policy and oversight of both private and public forests. One thing to note is that Western and Eastern Washington manage their forest differently due to variations in climate and forest stand species. In Western Washington, foresters practice clear-cut harvesting which allows for new seedlings to grow by reducing the competition for light. The Forest Practices Rules governed by the DNR establish laws that defines what proper management of forests look and feel like in Washington. These laws do not impact urban forestry, which is managed and governed by local municipalities.

WASHINGTON FORESTRY TODAY

- **18 million acres of Timberland in Washington**
- **Washington harvested 3,179,846,000 bf in 2013**
- **King County harvested 109,653,000 bf in 2013**

Seattle's Urban Forest

SUSTAINABLE | RESEARCH | MANAGEMENT | COMMUNITY

The city of Seattle has had a long history of supporting urban forestry in the region because of their awareness to the value trees provide in creating a livable and healthy city. Sited properly, trees can help reduce the need for hard infrastructural improvements by leveraging natural systems as soft or green infrastructure for stormwater management, cooling, and air quality that can help extend the life of existing infrastructural systems while increasing the ecological health of an area.

The management of an urban forest differs from that of a natural setting due to increased complexity related to development, public safety, infrastructure, and transportation. In addressing these concerns, the city has adopted a sustainable model for managing its urban forest. The sustainable model places a higher value on the services of the forest rather than on the production of goods. The city's model identifies three primary management strategies for monitoring and improving the existing urban forest:

Tree Resources: an understanding of the trees themselves, as individuals or in forest stands.

Management Framework: assignment of responsibility, resources, and best practices for the care of trees.

Community Framework: the way residents are engaged in planning and caring for trees.

The management of Seattle's trees occur through multiple departments of city government: Seattle Department of Transportation manages street trees, Seattle Parks and Recreation Department manages park trees, City Light maintains trees around utilities, and Public Utilities manages trees along creeks. The diverse nature of the urban environment and multiple managing bodies makes a comprehensive plan important for aligning efforts across landscape types amongst different stakeholders. To establish realistic urban forestry goals the city established unique goals based on different land use types (single family, multi-family, institutional, industrial, etc.) with a citywide goal of 30% and a institutional canopy goal of 20% by 2037. The University will follow a similar model by defining unique canopy goals for each campus neighborhood based on their specific land uses and available open space to meet and potentially exceed the city's institutional goal.

SEATTLE'S FORESTRY STRATEGIES

- **Optimize Forest Health & Environmental Benefits**
- **Increase Canopy Understanding**
- **Support Interdepartmental Efforts**
- **Proactive Management & Preservation**
- **Increase Public Awareness & Support**
- **Model Good Stewardship**

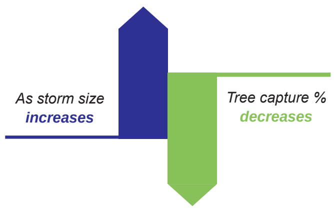
The Value of Urban Trees

ECOLOGICAL | SOCIAL | CULTURAL | VISUAL | PHYSIOLOGICAL

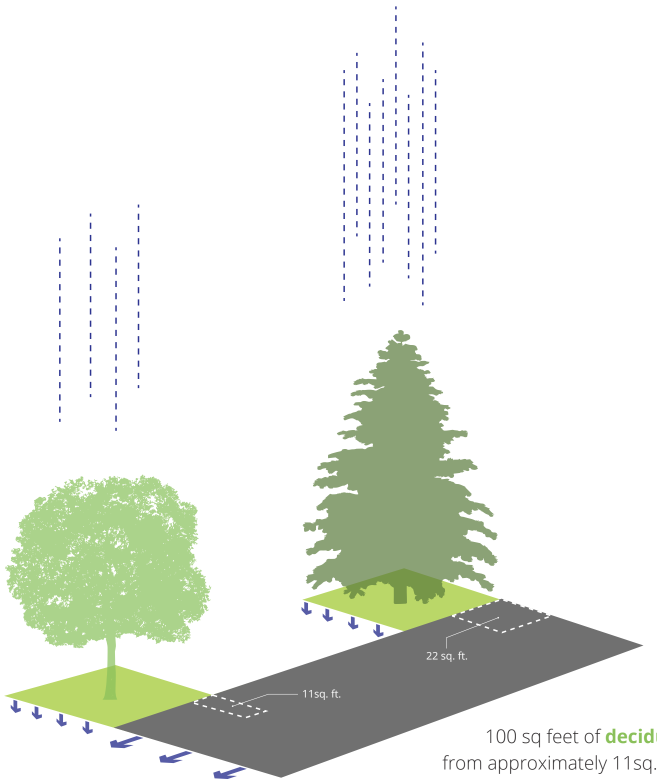
The value trees provide to cities is hardly tangible to the human eye, but is significant in terms of their positive impacts to human health, the ecology, wildlife and campus aesthetics. Overall, trees help make urban environments more livable through softening edges, cleaning the air, water, and soil, and providing color and shade to an otherwise harsh environment. As trees age, their benefits grow with their trunk size while also becoming more prominent in the landscape. Recently, there has become a surge in research validating the experienced relationship between the presence of trees, human health, safety, creativity, social values, decision making, crime and consumerism. In order to maximize their value, trees should be properly planted and maintained by residents and the local municipality based on their specific requirements. The following diagrams elucidate the multi-faceted benefits trees provide towards improving the living conditions for all creatures within cities.

STORMWATER MANAGEMENT

Trees help reduce the volume of stormwater that enter into municipal infrastructure and public waterways through interception, absorption, transpiration, and infiltration. These processes result in improved water quality and water quantity volumes. To fully manage stormwater on-site, trees need to be paired with other green stormwater infrastructure systems due to only being able to manage stormwater from an area 10 - 20% the size of their canopy area. In the Northwest, deciduous trees are dormant during the “wet” season, which reduces their stormwater management value in comparison to evergreen trees.



Deciduous Trees capture **1/2** the stormwater volume as **Evergreen Trees**

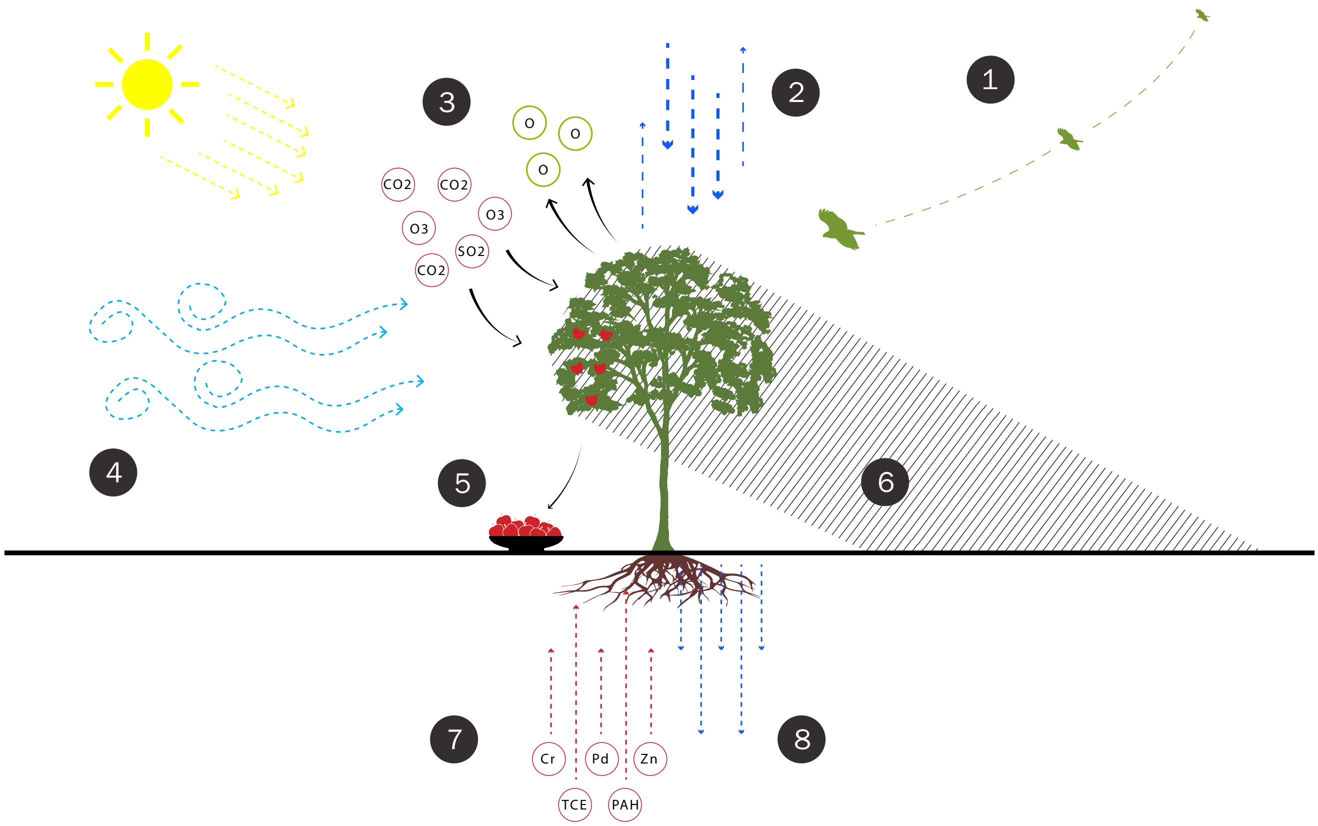


100 sq feet of **evergreen tree canopy manages** runoff from approximately 22sq. feet of nearby impervious surface

100 sq feet of **deciduous tree canopy manages** runoff from approximately 11sq. feet of nearby impervious surface

The Effects of Trees on Stormwater Runoff; Herrera Environmental Consultants, Inc., February 2008

Green Stormwater Infrastructure in Seattle, 2025 Implementation Strategy; Seattle Public Utilities



ECOLOGICAL BENEFITS

1 *Habitat*

Trees are able to provide food, shelter, and water for wildlife habitat. Habitat benefits vary based on tree density, health, and specie varieties.

2 *Stormwater*

The size of a tree and its foliage dictates how much stormwater it can absorb, intercept and evapotranspirate, which are important aspects of the water-cycle.

3 *Air Quality*

Trees aid in improving air quality by absorbing greenhouse gases and other toxins while releasing oxygen back into the environment.

4 *Wind*

Siting trees perpendicular to prevailing winds helps dissipate their power and can make harsh urban environments more pleasant.

5 *Food*

Trees can provide food for both human and wildlife consumption. Tree selection defines the types of food produced and their potential habitat benefit.

6 *Microclimate*

The shade produced by trees creates microclimates in the city by reducing the ambient air temperature within their shaded up to 23 degrees.

7 *Phytoremediation*

A select group of trees have the ability to uptake or stabilize contaminates within soil. Tree selection needs to be correlated with the existing soil toxin.

8 *Ground Water*

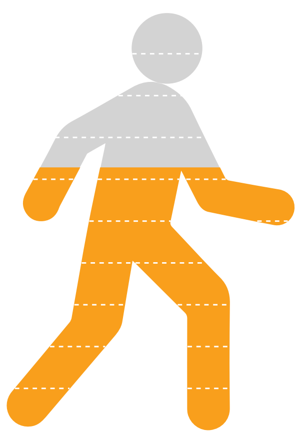
Trees promote the natural infiltration of stormwater, with their roots helping clean the water prior to it entering a ground water aquifer.

VISUAL BENEFITS

The visual presence of trees has been found to help reduce common ailments associated with the fast pace life of living in cities. Their presence can also help stimulate the mind resulting in increased creative inspiration and improved health.

PLANT TREES FOR SAFETY

Trees have been shown to make a place safer when they do not obstruct views at eye-level. Research has found that their is a relationship between obstructed views from first-floor windows and an increase in crime. In residential buildings, the top of first floor windows is on average 8.7 feet above grade. Recognizing this relationship can aid designers and managers in creating safe and pleasant environments across campus.



62%

of students say, "appearance of **GROUNDS** and **BUILDINGS** is the most influential factor during a campus visit"

INFLUENCE OF CAMPUS LANDSCAPES

Research has shown that prospective students are greatly influenced by the appearance of the landscape during a campus visit making maintenance integral to a university's success.

What Students Notice During a Campus Visit

http://www.olemiss.edu/depts/landscape/iowa.html

How clean, well-kept or orderly the campus is	*24%*
How pretty, beautiful or nicely landscaped	*24%*
Largeness of campus	*24%*
Architecture of buildings	*20%*
Friendly or happy place	*15%*
Traffic	*14%*
Smallness of Campus	*14%*
Campus Layout	*11%*
Town/city atmosphere	*6%*
Dorms/living arrangements	*5%*

Environmental Context

SOIL | TEMPERATURE | RAINFALL | SUN | WIND

Seattle's climate is described as temperate marine or Mediterranean, characterized by cool, wet winters and warm, dry summers. On average, Seattle receives only 4 - 6 inches of rain from May - September compared to 30 inches from October - March. This condition requires plants and trees to be irrigated during summer months, especially for establishment. This condition makes rainwater harvesting for summer irrigation challenging because of the lack of rain and the scale of system required to provide significant water for the dry months.

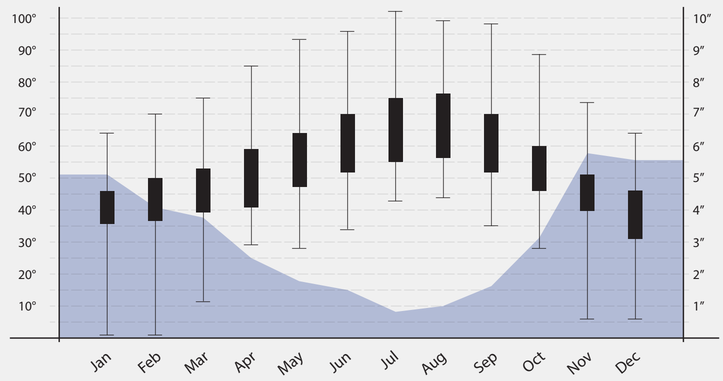
Seattle's Hardiness Zone is 30°- 35°/ 24"- 48", meaning this area has a low temperature of 30-35 degrees Fahrenheit with 24 - 48 inches of rain annually. Climate change has the potential to shift hardiness zones to the north making our climate warmer and drier which may alter the types of trees and vegetation that may thrive here in the future. Local cities are beginning to experiment by planting new varieties of trees from warmer hardiness zones to tests species for the impacts .

The sun path of this region encourages planting deciduous trees on the south and west sides of structures to reduce the amount of solar gain during the summer that reverses in the winter after they have lost their leaves. While, evergreens provide year around shade and wind protection.

One of the most challenging aspects of this region's ecology is the soil. Large deposits of a thick clay layer called Vashon Till was created during the ice age as the Vashon Glacier repeatedly advanced and receded thousands of years ago. The Vashon Till layer underlies most of the city, making drainage poor, establishing vegetation difficult and installing low-impact design strategies complex. Existing environmental conditions need to be evaluated prior to tree selection to identified a species best suited for the site.

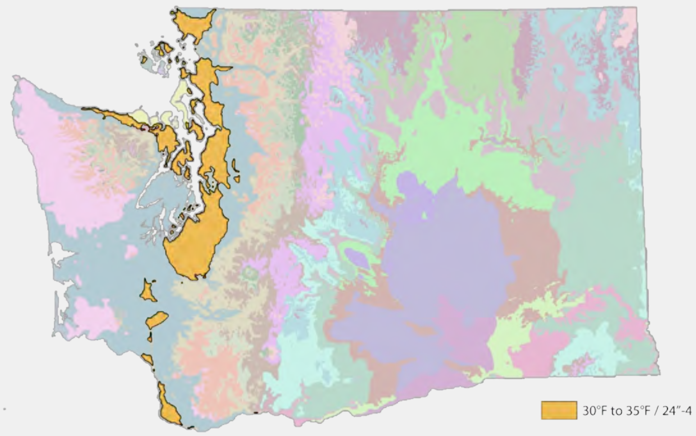
Average Annual Temperature and Rainfall

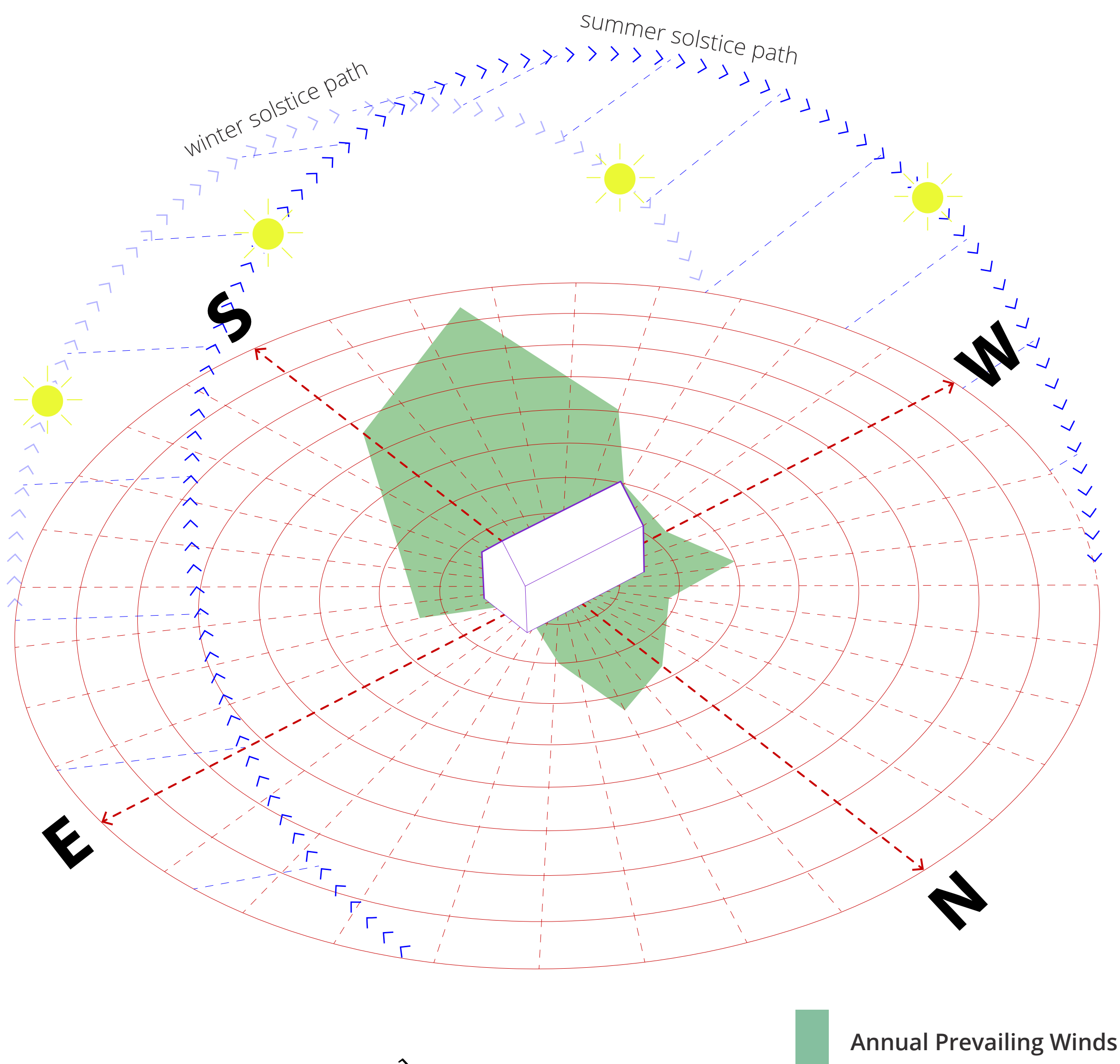
The Mediterranean climate of Seattle has warm dry summers with wet cold winters.

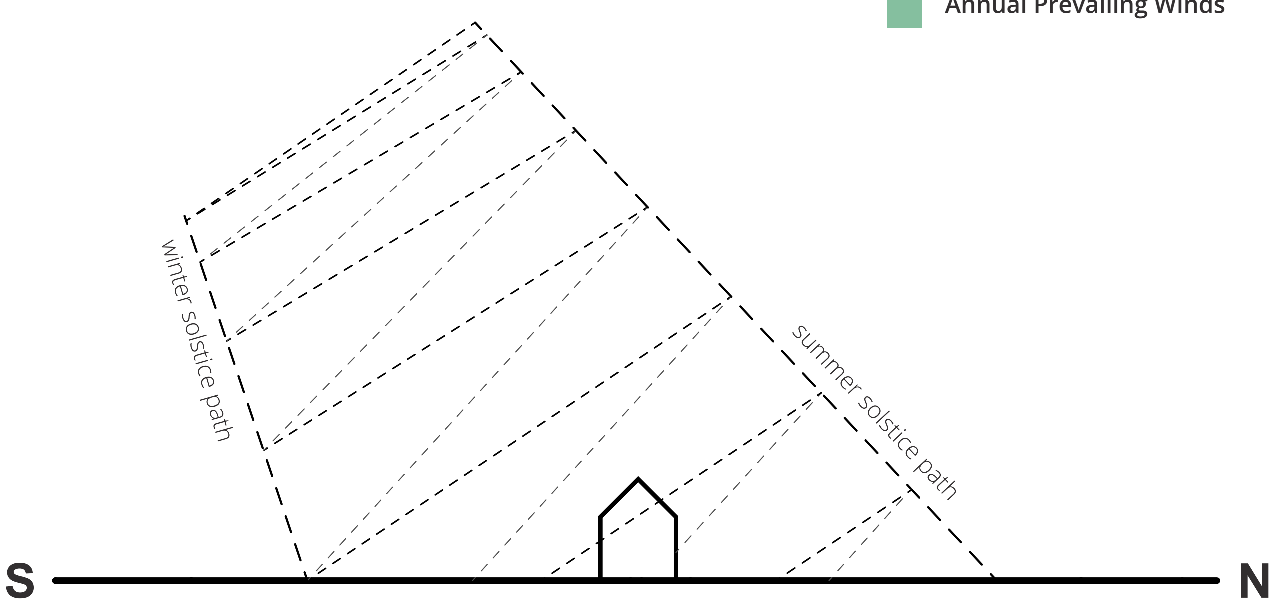


Hardiness Zone

Seattle is located in the 8b zone which promotes plants that are hardy down to 15 to 20 degrees.




summer solstice path
winter solstice path
S
W
E
N
Annual Prevailing Winds


winter solstice path
summer solstice path
S
N

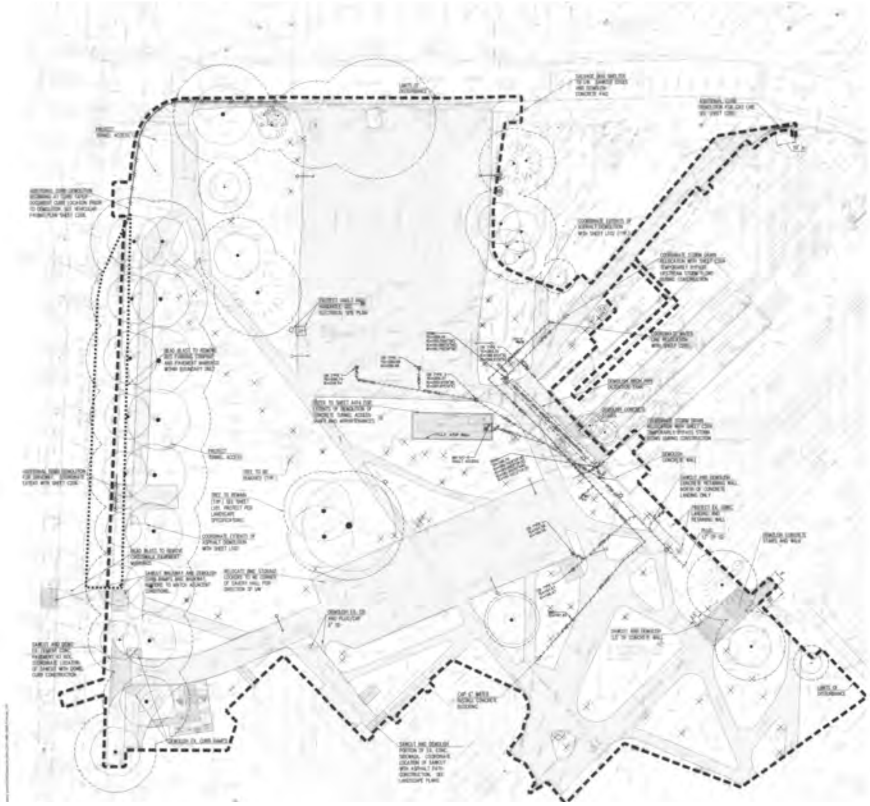
Development & Forest Ecology

BIOTIC | ABIOTIC | PERTURBATION | CATASTROPHE

Urban Forests, like natural forest are constantly being impacted by biotic (living) and abiotic (non-living) factors within an ecosystem. The constantly evolving human occupation of Seattle and UW's campus poses the greatest threat to the city's urban forest. Construction of building and roads, infestations of disease and insects, and physical damage caused by the public and weather reshape the urban forest daily. The intensity and scale of each impact shifts a forest's state of "equilibrium". Research shows that a state of non-equilibrium is favored over a static state, though a continuous reduction in canopy size, diversity, and number of trees is not prefered. Natural disturbances allow a stand to become diverse in age, type, and resiliency as the interaction between impact and recovery results in a healthier forest. The University recognizes the need for the landscape to change and evolve to meet the growing demand for new spaces where students and faculty can learn, live, work, play, and create; while also trying to maintain the integrity and grandeur of the campus's natural environment.

Improvements and new construction has been constant across campus resulting in new buildings, enhanced landscape features, increased accessibility, and expanded building footprints. With more development on the way and much more planned, a strategy for maintaining and managing one of the University's greatest asset, its natural environment is critical. The volume of projected growth makes establishing and achieving a static canopy goal difficult because with each new project comes new impacts that will alter the existing ecology of a site and potentially the University as a whole. Instead, the primary goal becomes developing a monitoring and management strategy that strengthens the presence of nature and its function while allowing for the expansion of land uses on campus. A balance between nature and edifice is required in the design, planning, and vision of the University of Washington Seattle campus.

PACCAR Hall



The site prior to construction of PACCAR Hall was a parking lot surrounded by a large canopy of evergreen and deciduous trees. The parking lot provide an area for the building to be sited without major impacts to the existing canopy.

Preserving the dense natural edge of the site was an important goal from the onset of the design. This was accomplished through strategically locating the building and developing the site logistics plan. This project highlights a process for building in Central Campus that accomadates the increase of academic space with the improvement and preservation of the site's natural ecology.

2

UW's Urban Forest

Man is nature as much as the trees

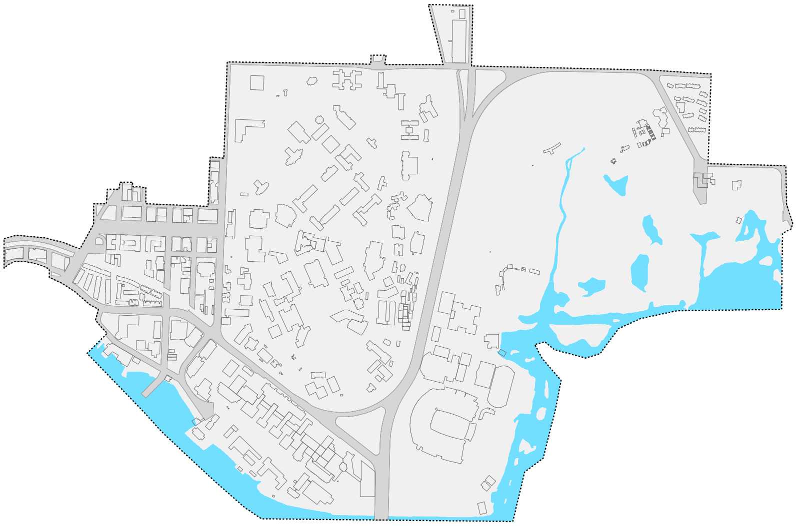
Daniel Urban Kiley

The University of Washington was carved out of a forest of trees, where reminisce of its grandeur still exist today at the campus edges. Framed by water and hills, the University consists of a mosaic of landscape types, each providing important environmental services that as a whole comprise a robust example of a range of northwest ecotones: conifer forest, deciduous forests, wetlands, steep and shallow slopes, and grasslands. The urban forest on campus is not only comprised of trees, but is experienced as the harmonious combination of vegtation and architect that leads to the iconic nature on the campus. Preserving and enhacing these attributes has the ability to benefit all life on campus for the better. In order to establish goals and strategies related to the Urban Forest, a baseline needs to be defined for which all future changes will be compared with to understand the progress and value of subsequent efforts. As part of this analysis, the campus is evaluated as a whole and as four distinct neighorhoods to identify multi-scalar aspect of the system that can be improved to acheive our Urban Forestry goals.

Land Cover

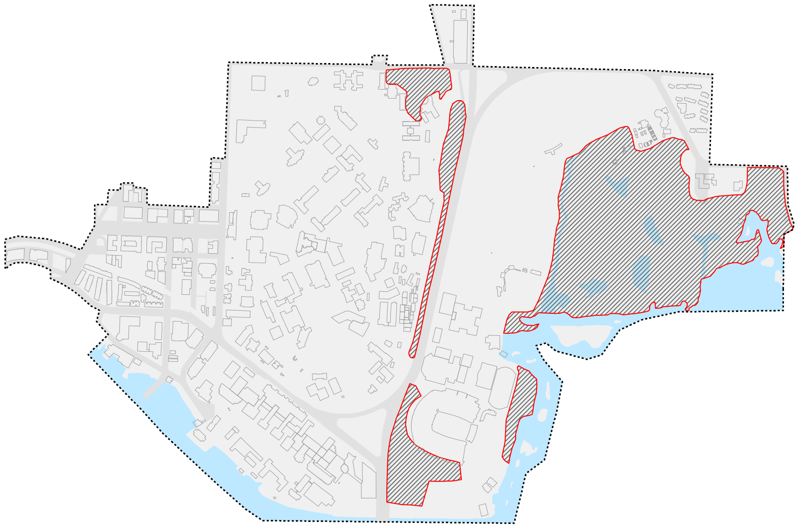
665.5 ACRES | LAND | WATER | BUILDINGS | INFRASTRUCTURE

The focus area for the tree inventory is within the surveyed areas of the University's Major Institution Overlay or MIO. The MIO defines the area that the University is required to manage to standards set by the university and city; this includes all hardscape, softscape, buildings, vegetation, utilities, and water that falls within the boundary. One thing to note is that some areas of campus (see map below) have not been inventoried and are thus not inlcuded in this analysis. However, they do provide significant value to the campus's urban forest and are included as part of the University's tree canopy analysis. To establish a baseline for analyzing the urban forest, the existing ground conditions have been quantified by thee primary land use types found on campus: architecture, infrastructures, water, and land. The 665.5 acreas of land within the MIO is greater than UW's ownership due to the inclusion of the public right-of-way.



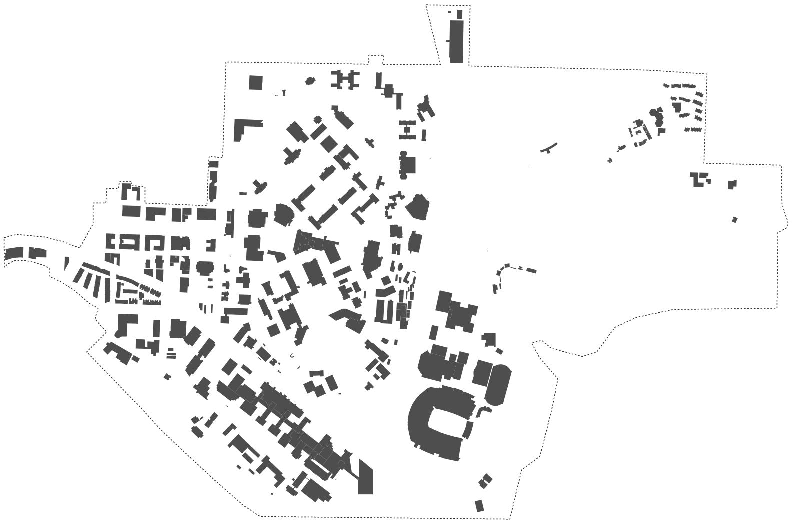
Land Cover

Total Area:	**665.5 acres** 100%
Land :	**538.41 acres** 80.9%
Water :	**64.84 acres** 9.7%
Public ROW :	**62.25 acres** 9.4%



Future Areas to be Surveyed

Total Area :	**111.62 acres** 16.8%
Land :	**103.68 acres** 15.6%
Water :	**7.94 acres** 1.2%



Building Coverage

# Buildings :	**343**
Total Area :	**100.83 acres** 15.2%

Tree Database

GIS | GPS | ASSETMAPPER | FIELD SOLUTIONS

The following analysis of the University of Washington Seattle campus's urban forest was completed using ArcGIS 10.2, Microsoft Access, Illustrator, InDesign, AutoCAD, and Microsoft Excel. The tree database was acquired in August of 2014 from the campus arborist who regularly updates the database when trees are planted or removed. With the campus in constant flux, this analysis represents a snapshot in time that establishes a baseline for moving forward in enhancing the UW's Urban Forest.

The creation of a GIS Tree Database began in September 2005 when UW Seattle's Grounds Management started to develop a tree inventory with the goal of qualifing and quantifing every tree on campus. The initial effort mapped approximately 9,500 of an estimated 11,000 trees on the Seattle Campus with information relative to height, caliper and their type. The initial analysis needed to be expanded upon, so a Campus Sustainability Fund grant was acquired to hire a consultant and students to conduct a comprehensive forest resource assessment. The result of the data collection was a robust database and an-house GIS interface that allowed University Grounds' personal to access and update tree data in the field using a cell phone or tablet device.

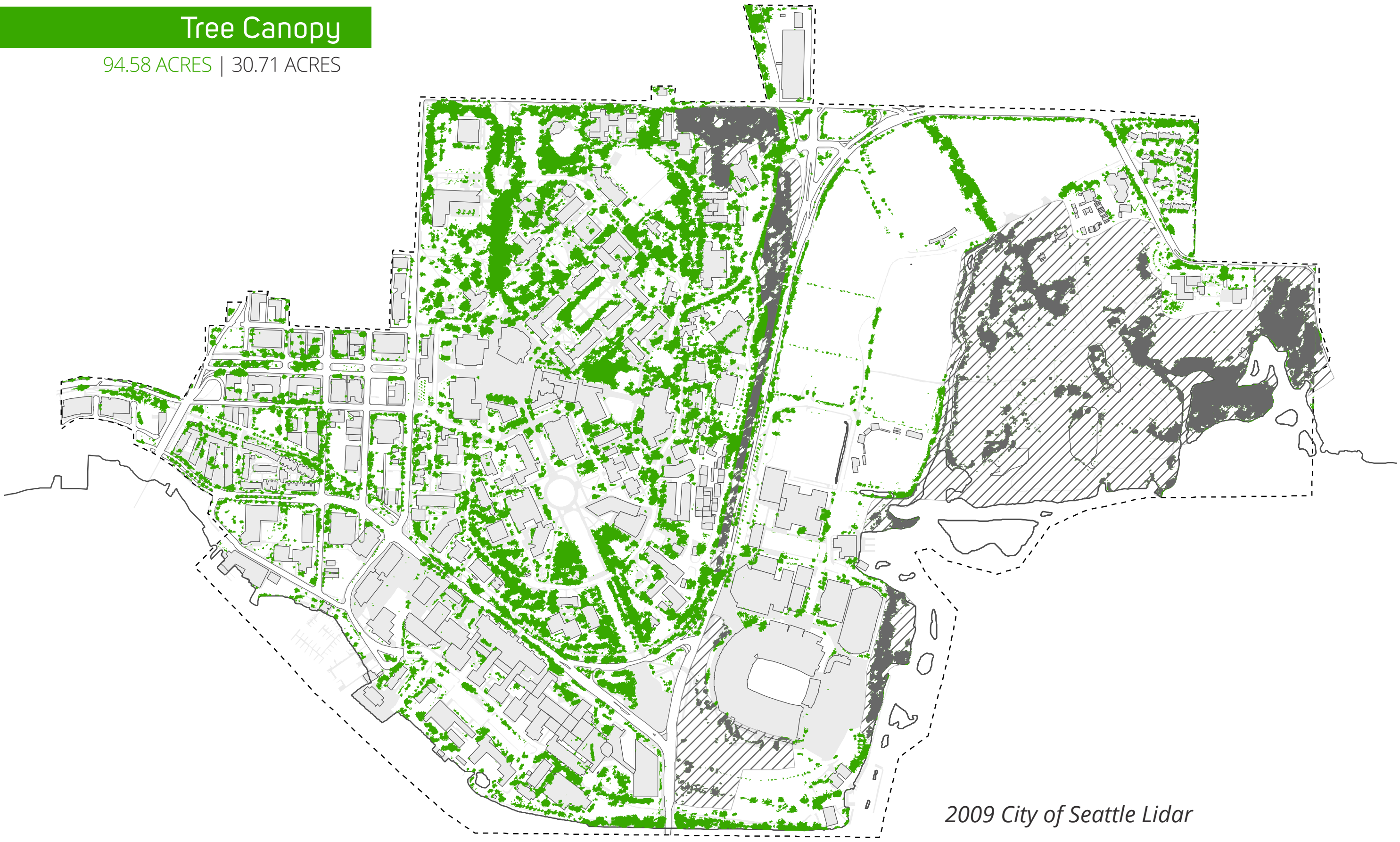
The GIS mapping tools also allows the campus arborist to monitor all trees on campus, while being able to preserve historic data, providing a historical narrative for the trees on campus. Notes and additional data can also be time stamped within the database making the information more robust. A publicly accessible dataset of the campus trees dataset is available through WAGDA 2.0; a university specific data portal giving students and researchers access to the information for data analysis.

The data used for the canopy cover analysis was derived from a lidar scan completed by the City of Seattle in 2009. Since then, the campus has gone through substantial change, making the canopy analysis less accurate than the tree inventory. The University is working with the city and other stakeholders to define a process for having the campus scanned more frequently to gain a better understanding of the relationship between development and the urban forest.

The other data used to create all of the maps that follow were acquired from the WAGDA 2.0 database and the University of Washington internal GIS databases. This includes building outlines, landscape feature outlines, pavement edges, shoreline, MIO boundary, and right-of-way.   All additional map data is approximated by georeferencing hardcopy maps using known points and then tracing the features into a new feature class.

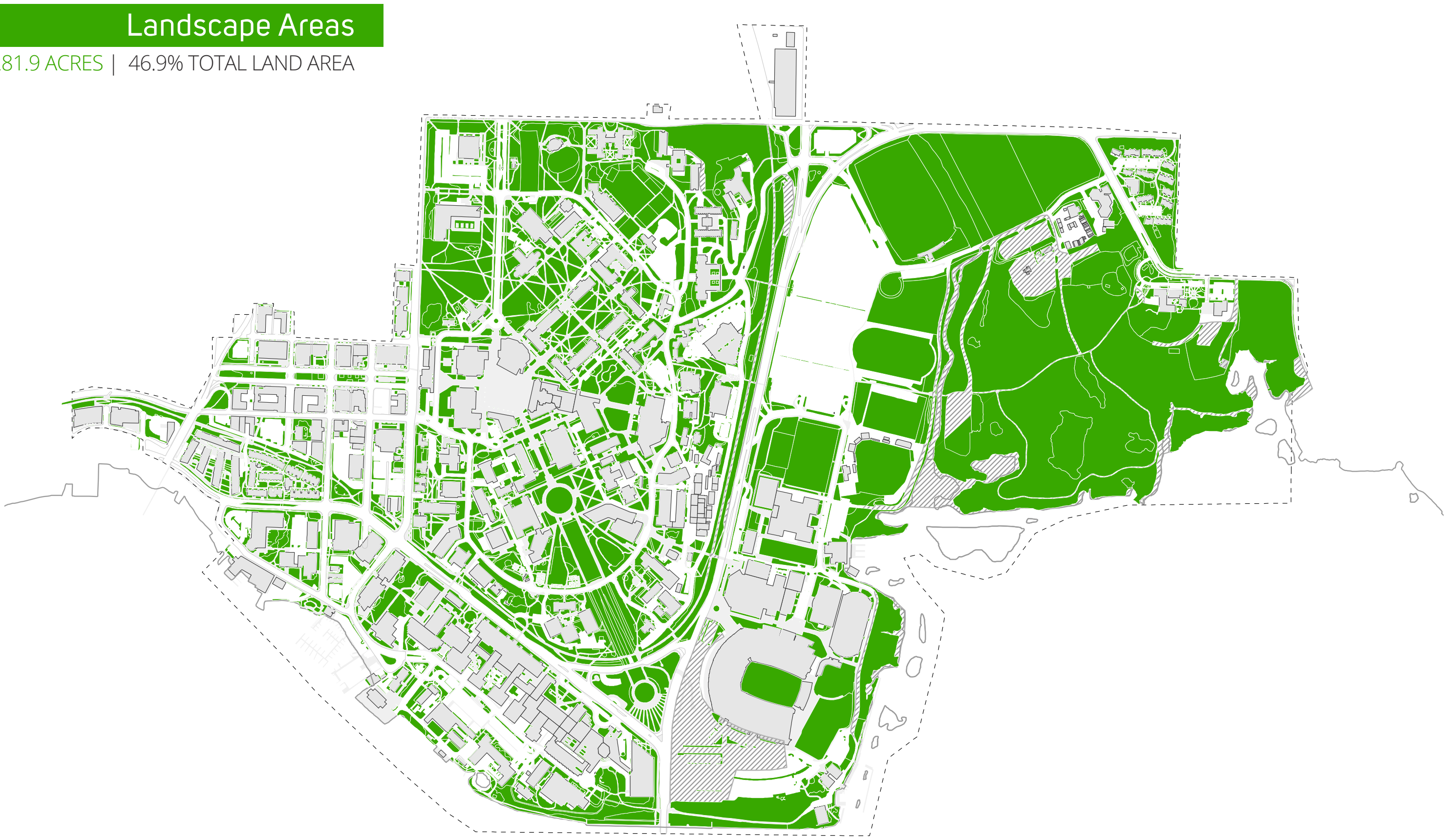
Tree Canopy

94.58 ACRES | 30.71 ACRES



Landscape Areas

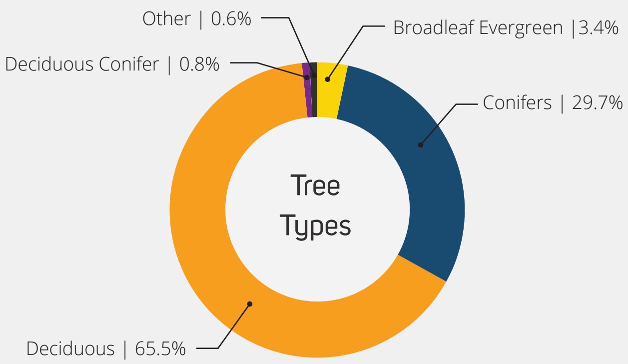
281.9 ACRES | 46.9% TOTAL LAND AREA

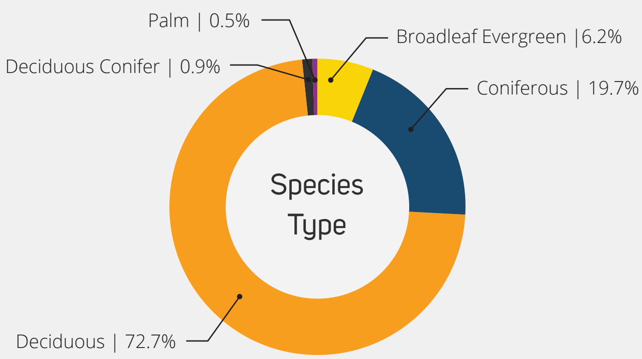


All Trees

8,274 TREES | 417 SPECIES

The Seattle campus has 8,274 trees, ranging 417 different species with each providing value to the character and quality of the landscape experience. The health and diversity of the University's forest speaks to the Husky spirit of stewardship to the campus and the local environment. Through strategic care and management the University strives to provide a diversity of trees and distinct landscapes that emphasizes the variety of ecological zones that are native to the Pacific Northwest; from herbaceous wetland to Lowland Conifer-Hardwood Forest. Continuing to enhance the campus's biodiversity while improving the overall health of the urban forest is paramount for minimizing potential tree loss due to pests and severe weather. The trees paired with the landscape act as an educational resource that pushes the classroom outside of buildings to encourage hands-on, experiential learning techniques that help realize the vision of the landscape being a living laboratory for students, faculty, and staff. Growing this campus resource by increasing the number of species and trees on campus will help build upon the University of Washington's legacy of being good .

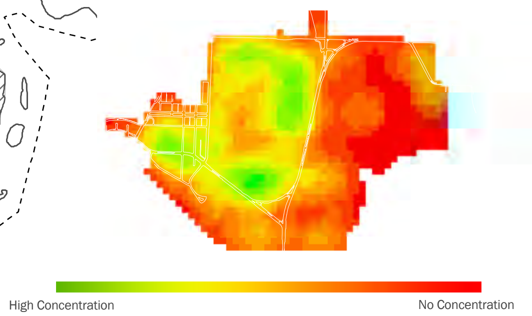




Most Common Species

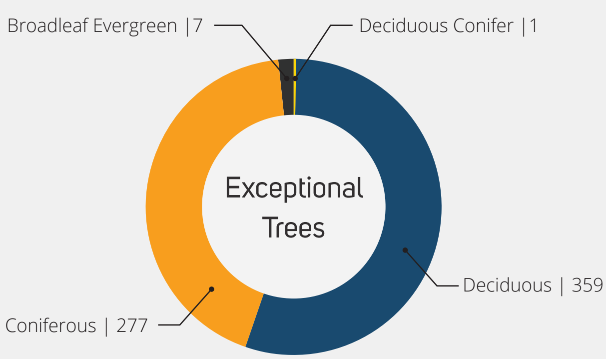
Tree Species	# of Trees	Condition Rating
Pseudotsuga menziesii	*448*	*78.72%*
Acer macrophyllum	*396*	*70.69%*
Acer circinatum	*305*	*79.88%*
Chamaecyparis lawsoniana	*264*	*74.52%*
Pinus sylvestris	*199*	*73.34%*
Thuja plicata	*199*	*78.56%*
Quercus rubra	*195*	*75.54%*
Acer rubrum	*162*	*73.13%*
Calocedrus decurrens	*156*	*77.81%*
Platanus x acerifolia	*152*	*69.52%*

All Trees

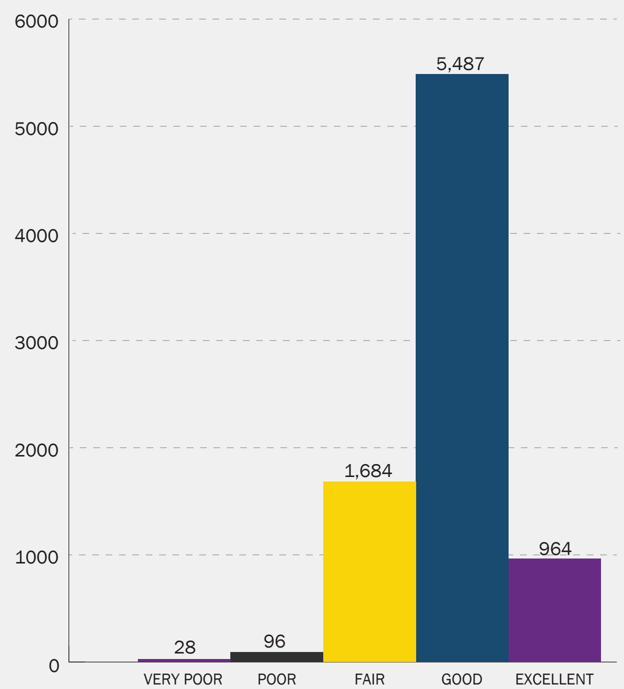


75.5%
AVERAGE CONDITION RATING

$35,106,400
TOTAL TREE VALUE



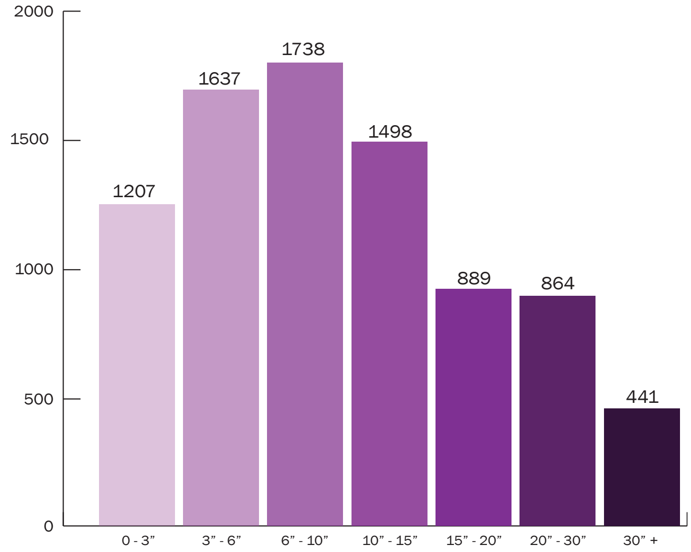
TREE CONDITION



Diameter at Breast Height

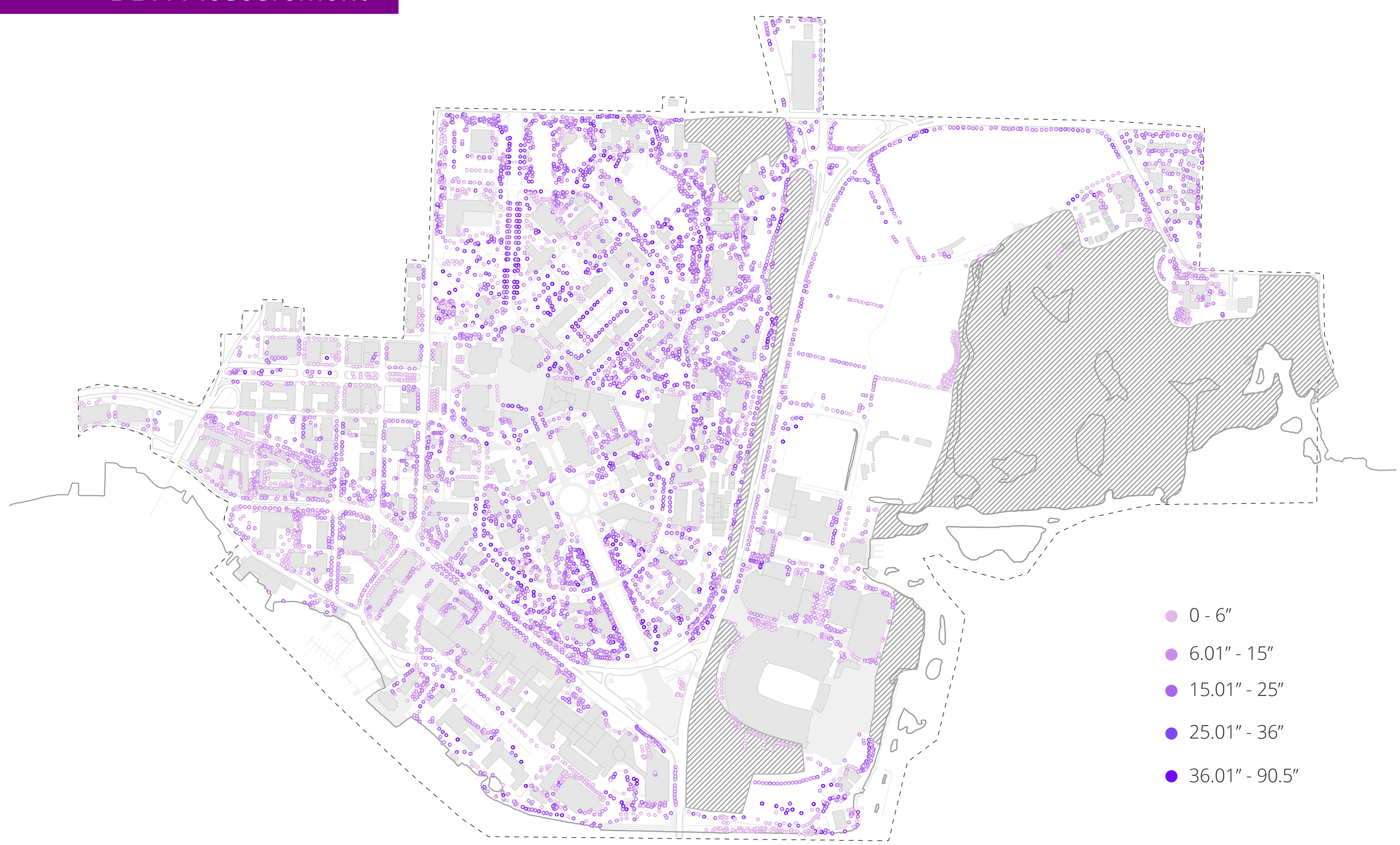
EXCEPTIONAL | CALIPER | DBH

The Diameter at Breast Height measurement or DBH is a standard dimension taken at 1.4 meters above the base of the tree. The DBH measurement can be used to extrapolate other dimensions of a tree; tree height, crown volume, and age. The city of Seattle uses this measurement to define which trees are and are not exceptional. The majority of trees on campus have a DBH less than 15 inches with only 441 above 30”. It is important for the University to have a range of trees with varying DBH's to provide a diverse urban forest that consists of a range of species at different sizes and ages.



Quantity per DBH Range

DBH Measurement

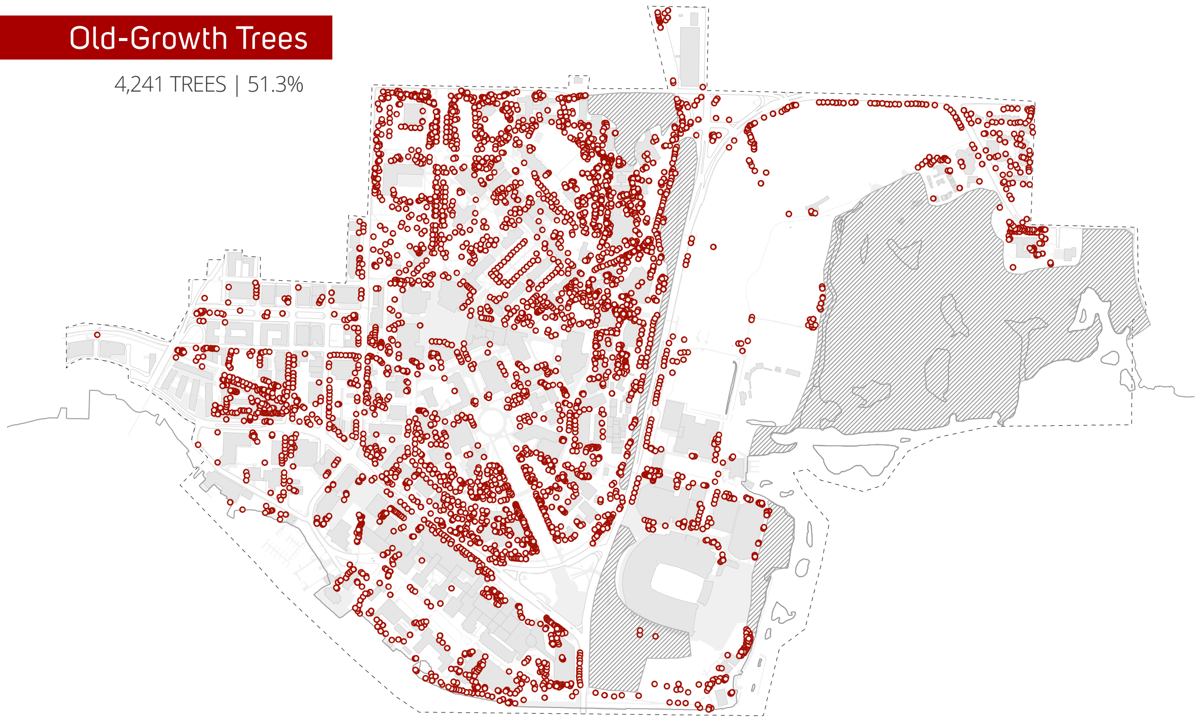


Tree Age

A healthy forest is comprised of trees with varying ages to help reduce the possibility of simultaneous large volumes of tree loss. The age of trees has been derived from comparing their existing height to their potential max height and then dividing them into three categories: young, middle, old. This revealed that a little over half of the existing trees on campus are at the end of their life; which means there is a need to diversify the ages of trees on campus by strategically adding new trees annually with new construction projects, systematic tree replacement, and planting events.

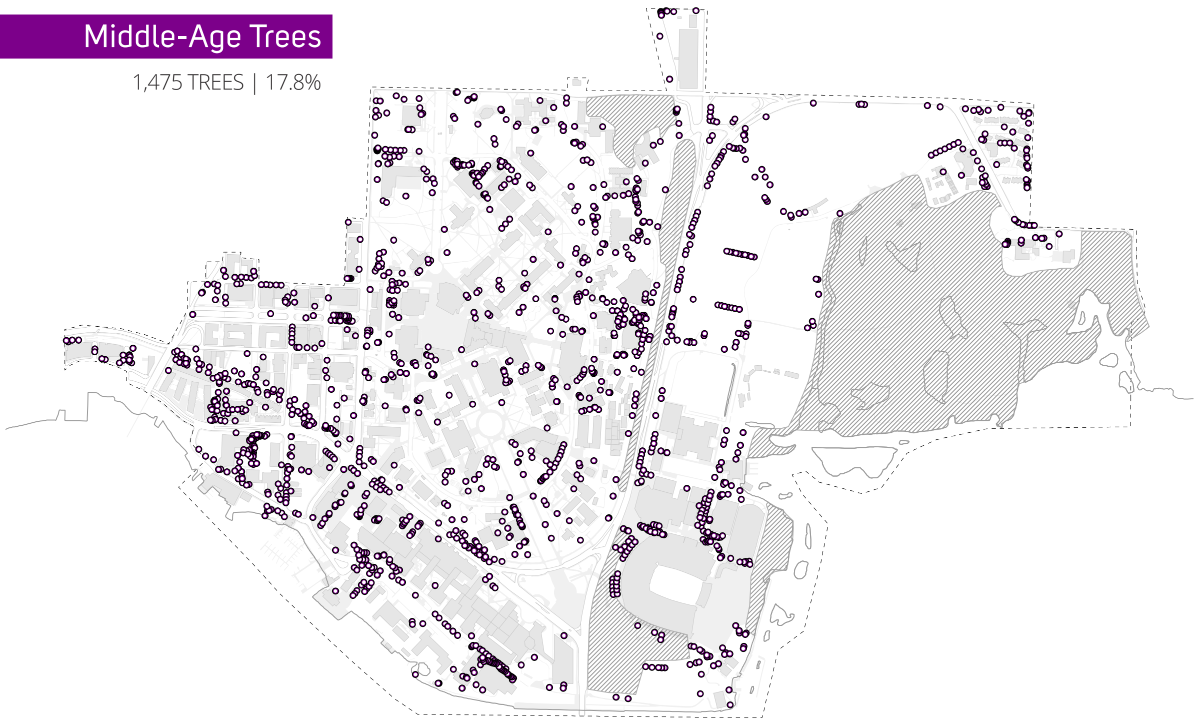
Old-Growth Trees

4,241 TREES | 51.3%



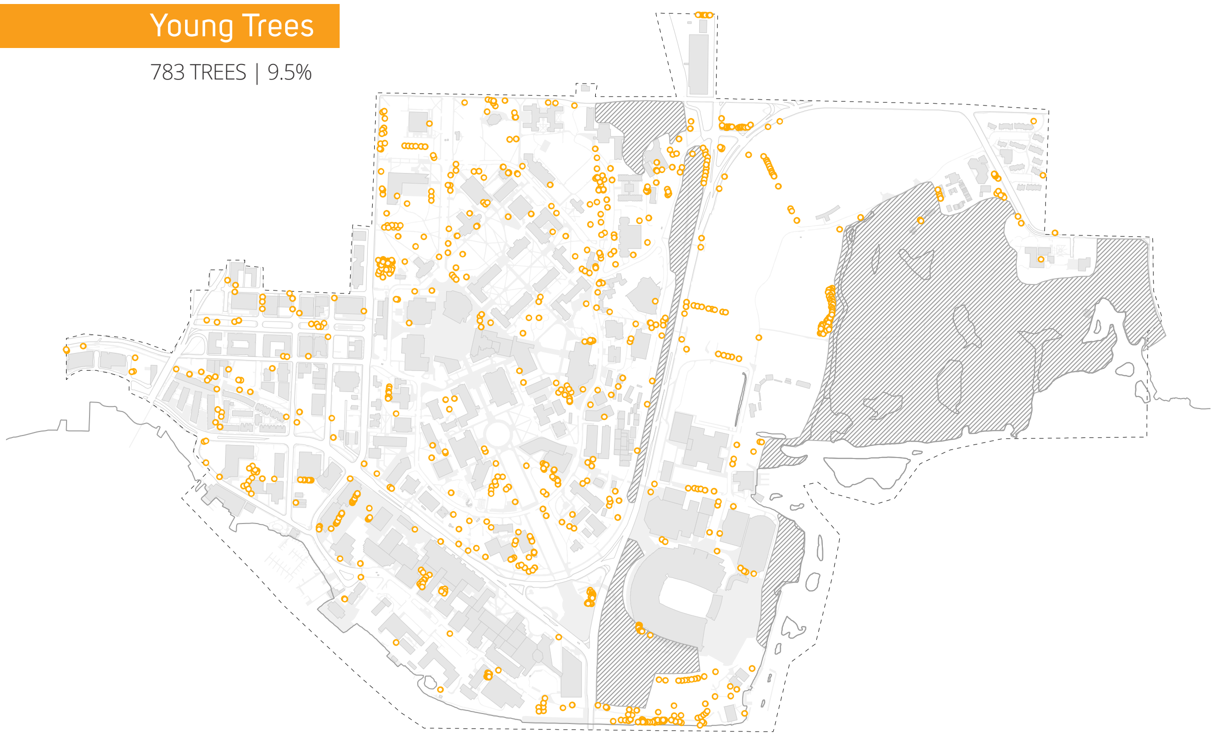
Middle-Age Trees

1,475 TREES | 17.8%



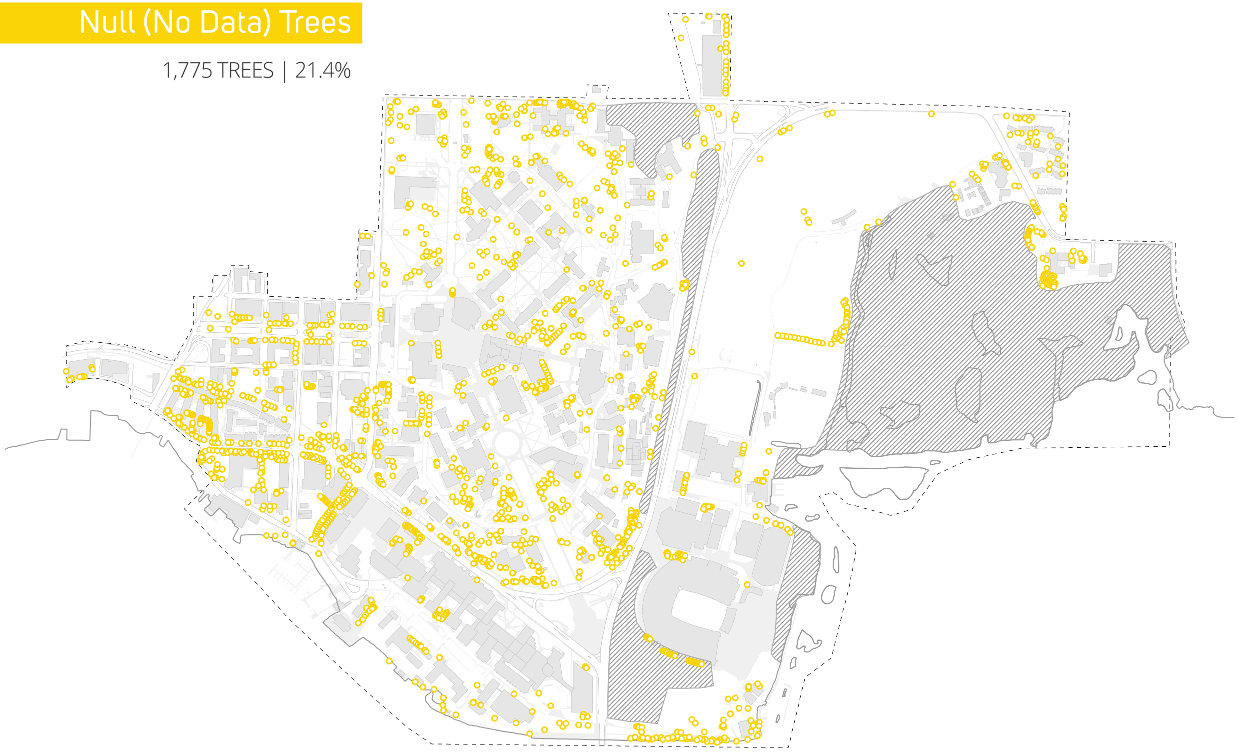
Young Trees

783 TREES | 9.5%



Null (No Data) Trees

1,775 TREES | 21.4%

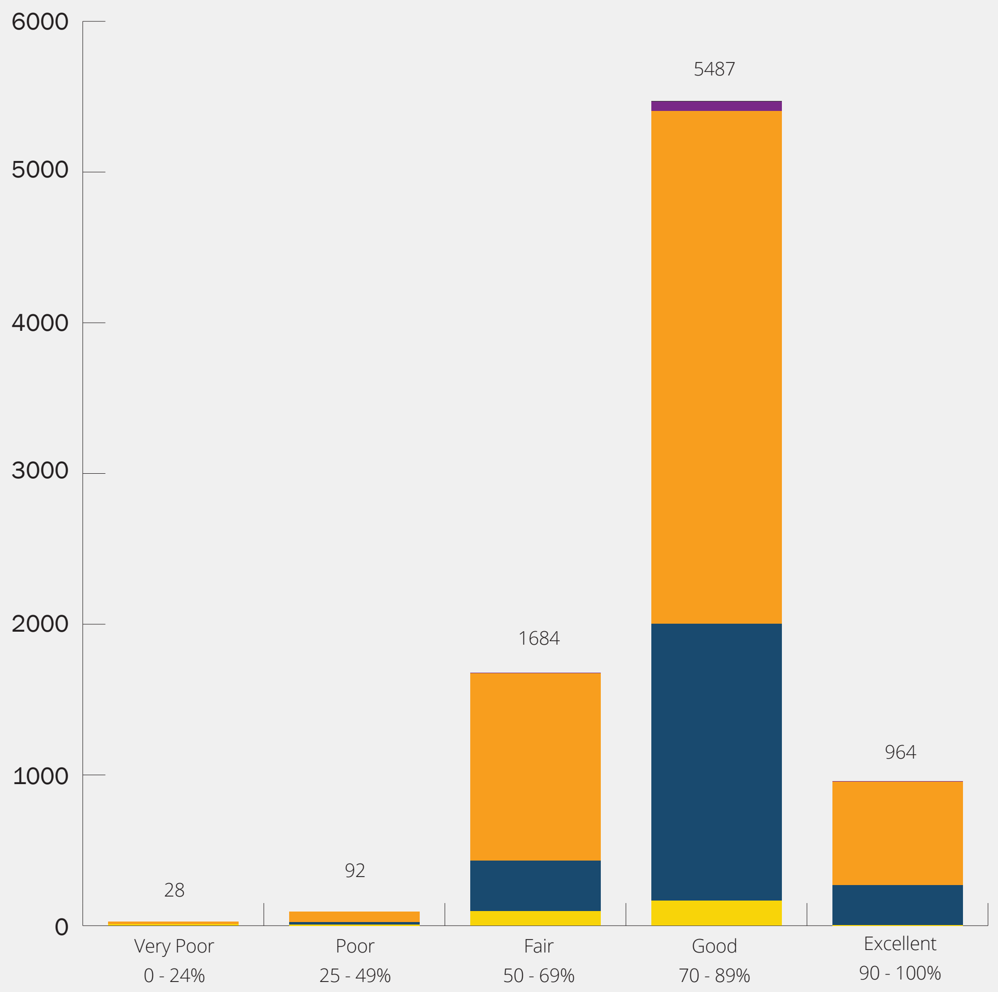


Tree Condition

EXCELLENT | GOOD | FAIR | POOR | VERY POOR

The University has implemented a robust management strategy to keep its urban forestry healthy and thriving for generations to come. With approximately 78% of the trees on campus being in Good or Excellent Condition, students and visitors are exposed to an amazing example of a healthy Northwest Forest that consists of both common and rare specimens to the Puget Sound Region. The University has an arborist on staff who establishes and implements best management practices for keeping the campus's forest at its optimal performance. The level of maintenance that each landscape area receives varies based on their historic significance, visibility, and aesthetic quality. The goal of management is to continue to increase the diversity and scale of its urban forest by promoting the health, safety, and economic value of each tree. The formula used to quantify the condition of each trees is as follows:

(crown + trunk + branch structure + twig growth + foliage + insect & disease + roots) / 35 = Condition Rating %



75.58%
Average Tree Condition

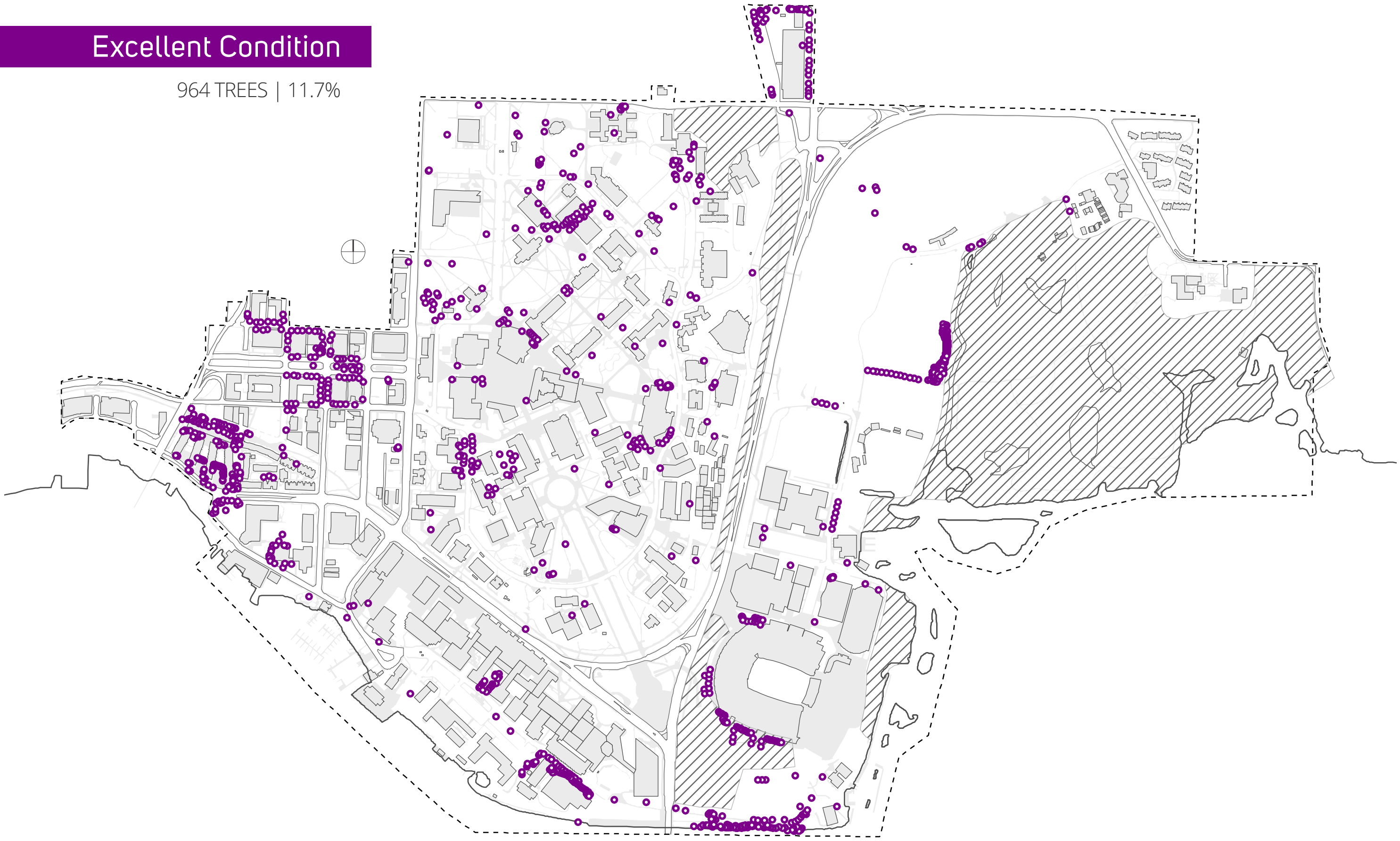
11.7%
Excellent Condition

Overall Tree Condition

- Palm
- Deciduous Conifer
- Deciduous
- Coniferous
- Broadleaf Evergreen

Excellent Condition

964 TREES | 11.7%



THE BEST* AND WORST

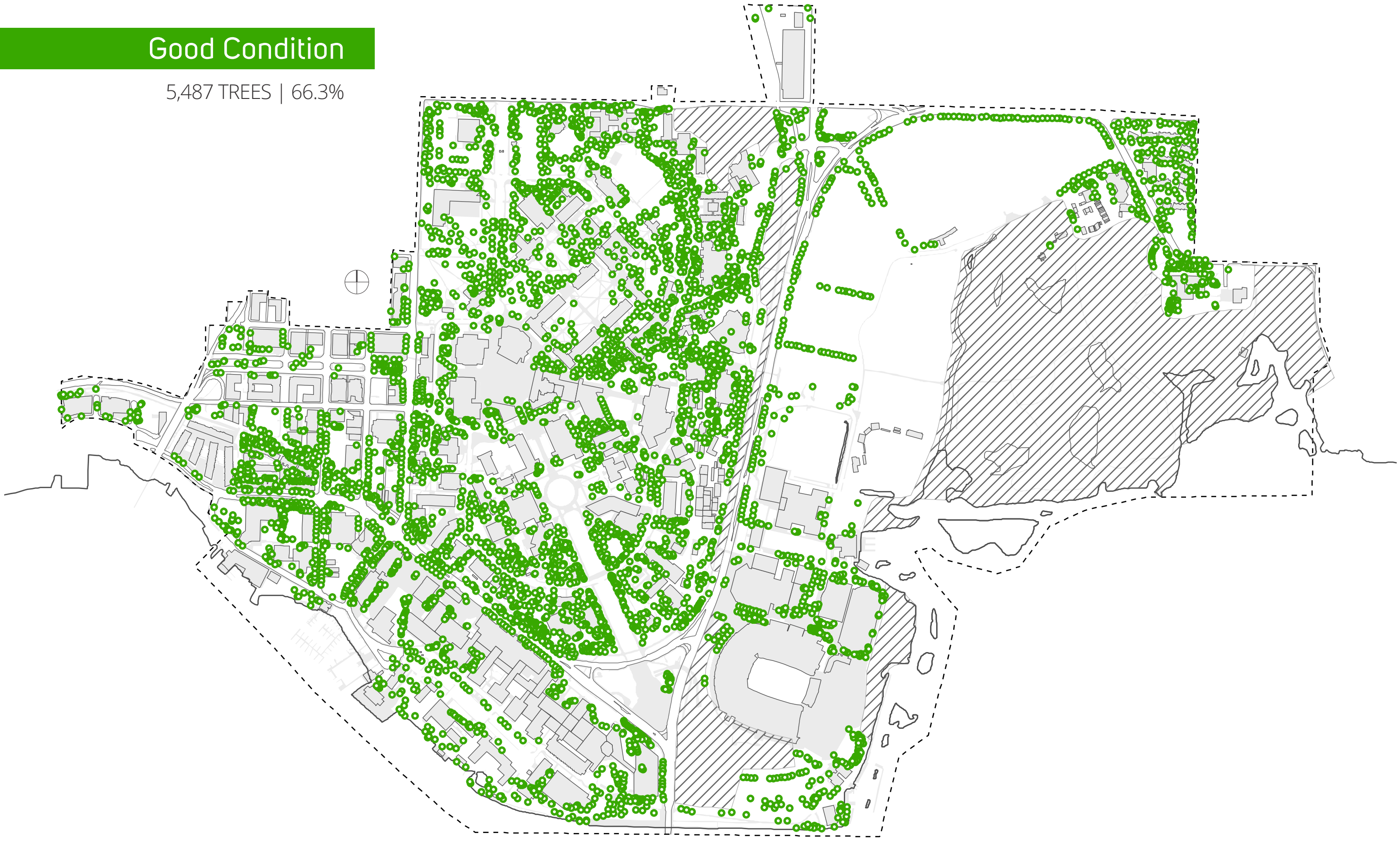
Tree Species	# of Trees	Average Condition Rating
Magnolia x soulangeana	*2*	*90.00%*
Fagus grandifolia	*7*	*85.14%*
Tilia spp	*8*	*84.88%*
Trachycarpus fortunei	*2*	*84.50%*
Quercus macrocarpa	*2*	*84.00%*
Davidia involucrata	*2*	*83.00%*
Zelkova sp	*26*	*82.88%*
Viburnum sp	*2*	*82.50%*
Tsuga canadensis	*2*	*81.50%*
Sequoiadendron giganteum	*14*	*81.43%*

** DBH > 8 & # > 1*

Tree Species	# of Trees	Average Condition Rating
Pterostyrax psilophylla	*1*	*57.00%*
Elaeagnus angustifolia	*1*	*57.00%*
Acer grosseri	*1*	*57.00%*
Catalpa speciosa	*3*	*55.00%*
Prunus subhirtella 'Whitecomb'	*4*	*53.00%*
Picea rubens	*1*	*51.00%*
Acer tegmentosum	*1*	*46.00%*
Eucalyptus gunnii	*1*	*40.00%*
Prunus subhirtella 'Pendula'	*1*	*40.00%*
Acacia melanoxylon	*8*	*32.88%*

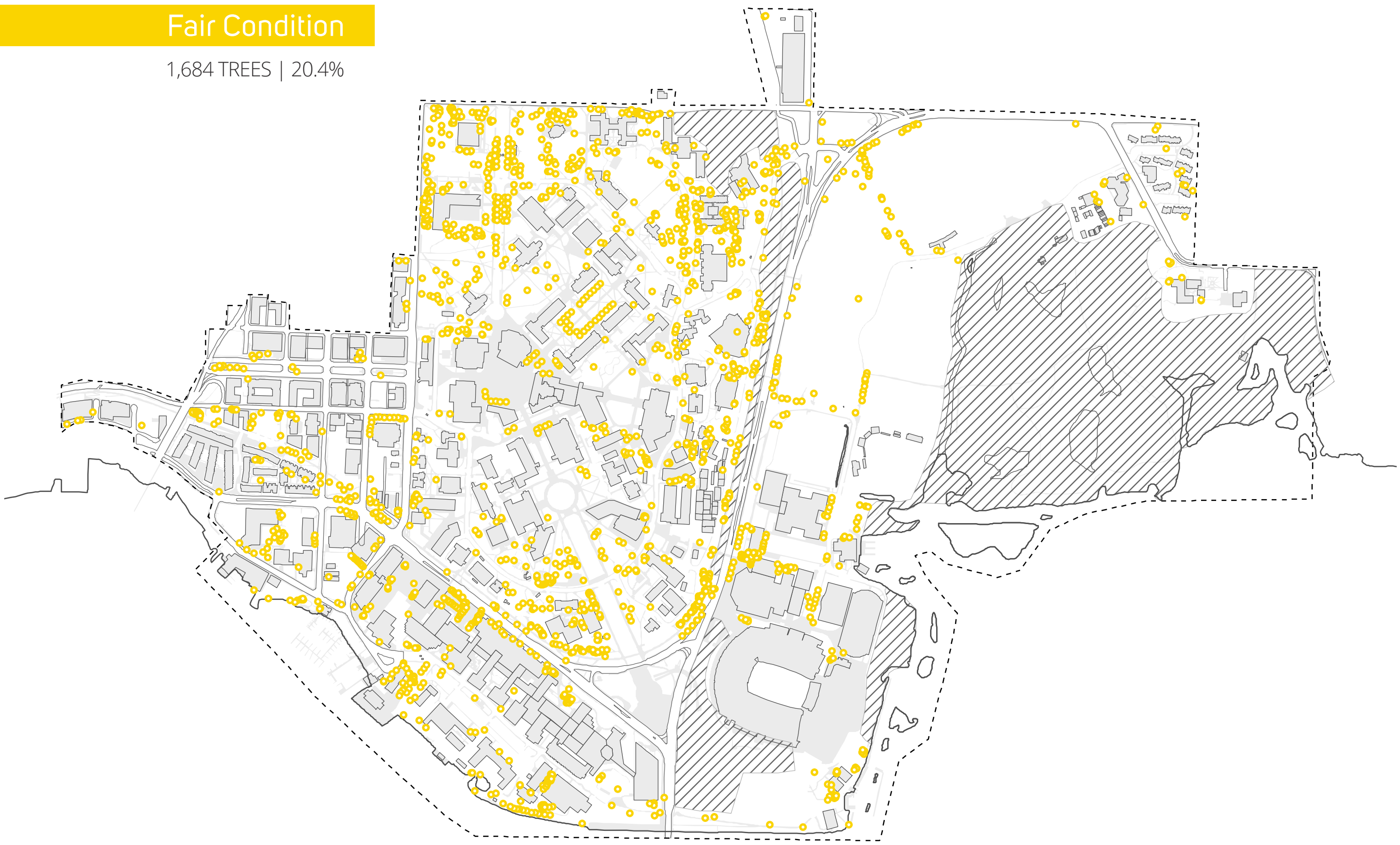
Good Condition

5,487 TREES | 66.3%



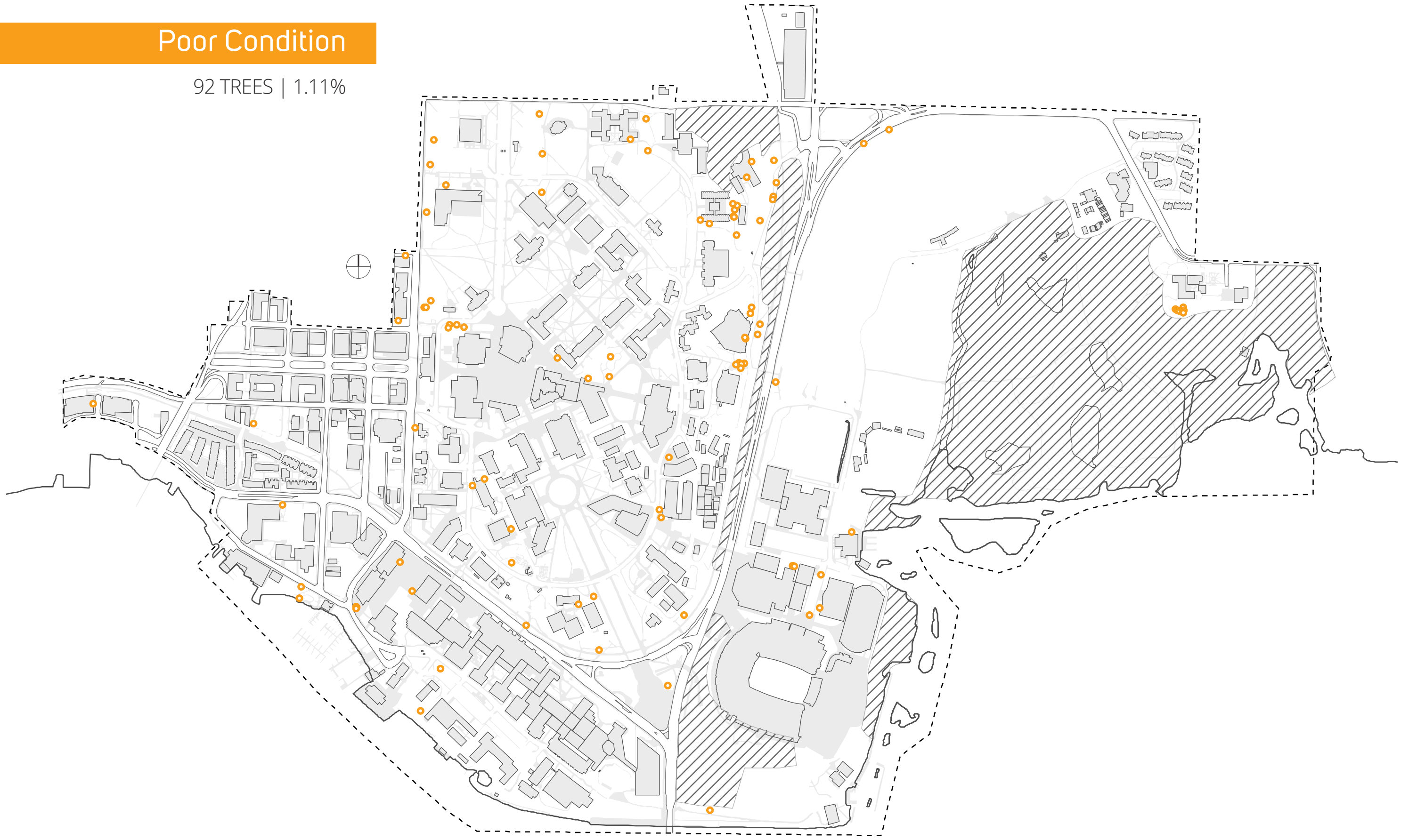
Fair Condition

1,684 TREES | 20.4%



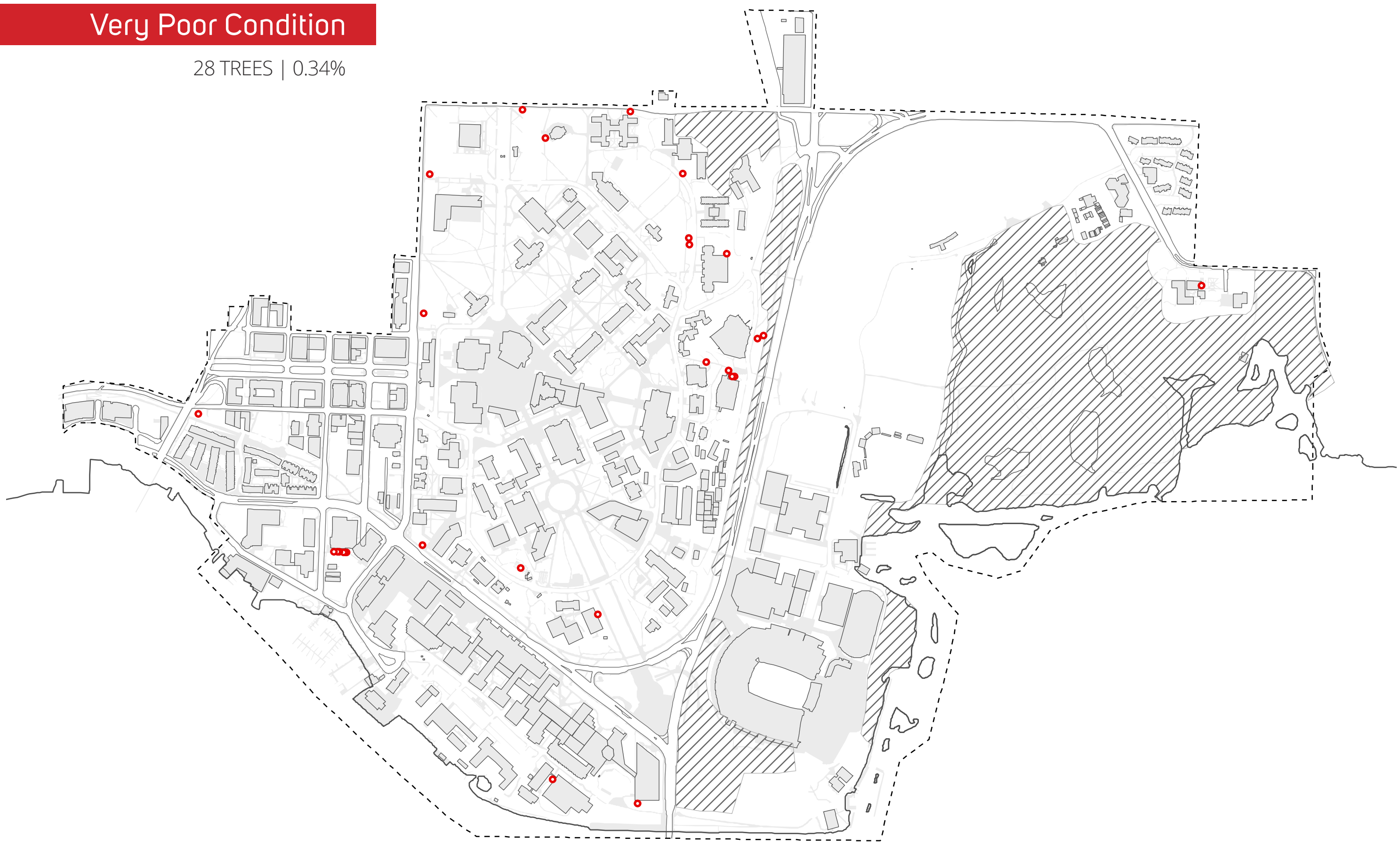
Poor Condition

92 TREES | 1.11%



Very Poor Condition

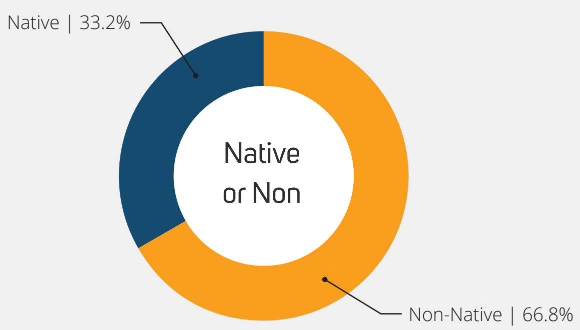
28 TREES | 0.34%

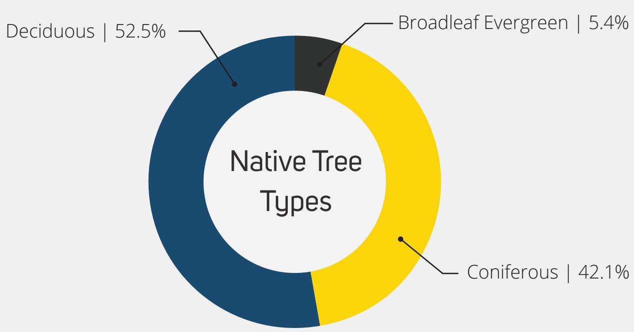


Native Trees

2,704 TREES | 49 SPECIES

Native Trees are valuable assets to the campus because of their natural acclimation to the Northwest climate and their benefit to wildlife habitat. Native trees have naturally aligned their watering and nutrient needs with the local climate which reduces irrigation requirements, reduces disease risk, enhances the local ecology, and helps limit the introduction of potential invasive species into the landscape. The University has slightly less number of native conifers compared to native deciduous trees. With only 49 native tree species on campus, the university has the opportunity to enhance the biodiversity and improve wildlife habitat by introducing more native species into the landscape. The University recognizes the benefits of native trees but also feels that a healthy Urban Forest needs to respond to the existing conditions which are greatly altered from what was present historically, making natives not always the most ideal choice. Without fully being aware of the impact climate change will have on the region, exploring non-natives species could be a means towards identifying which tree species may thrive here in the future.



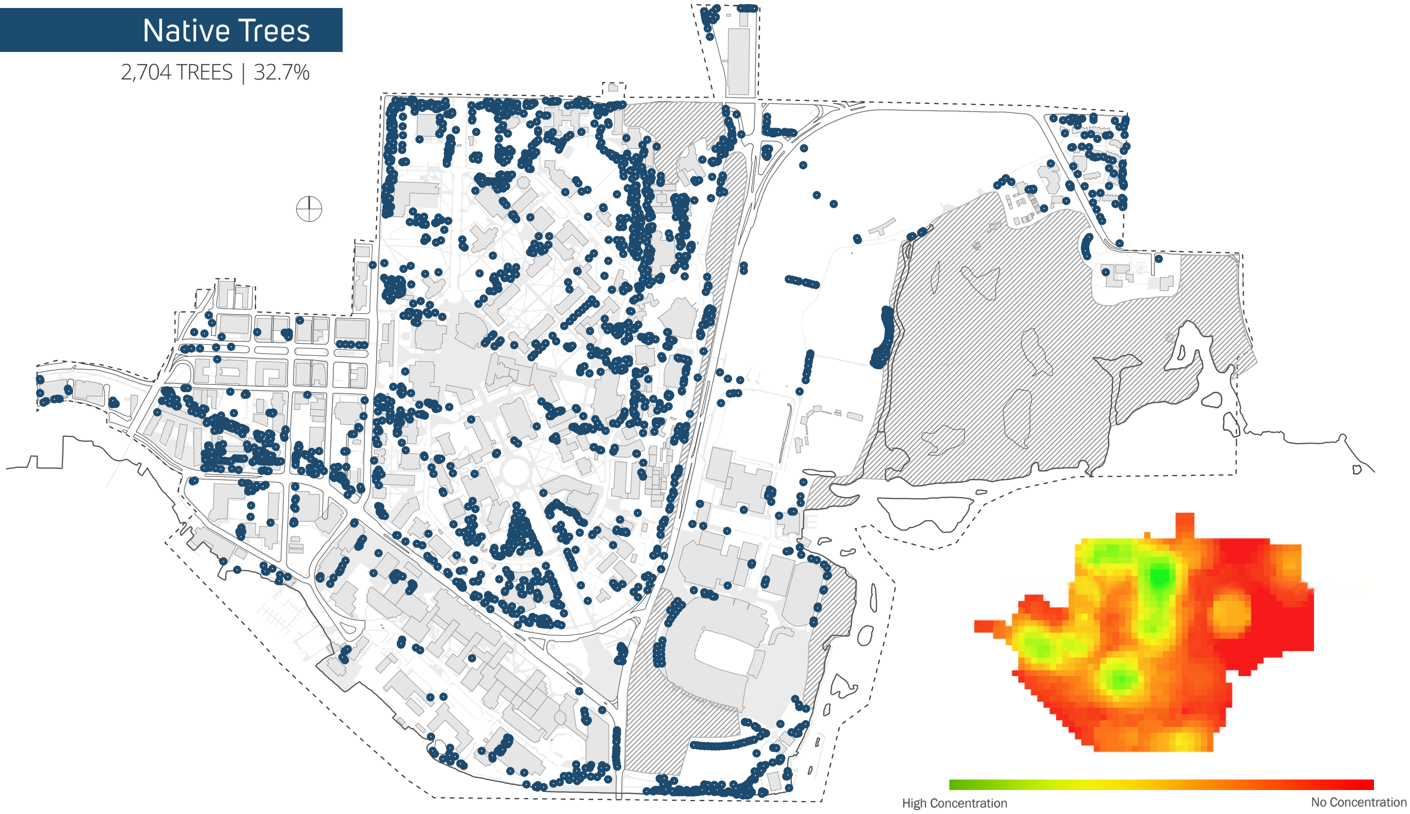


Most Common Native Species

Tree Species	# of Trees	Average Condition Rating
Pseudotsuga menziesii	*448*	*78.72%*
Acer macrophyllum	*396*	*70.69%*
Acer circinatum	*305*	*79.88%*
Thuja plicata	*199*	*78.56%*
Calocedrus decurrens	*156*	*77.81%*
Betula pendula	*129*	*73.66%*
Pinus contorta	*120*	*72.42%*
Arbutus menziesii	*103*	*65.50%*
Acer platanoides	*88*	*77.65%*
Thuja plicata 'Zebrina'	*76*	*75.16%*

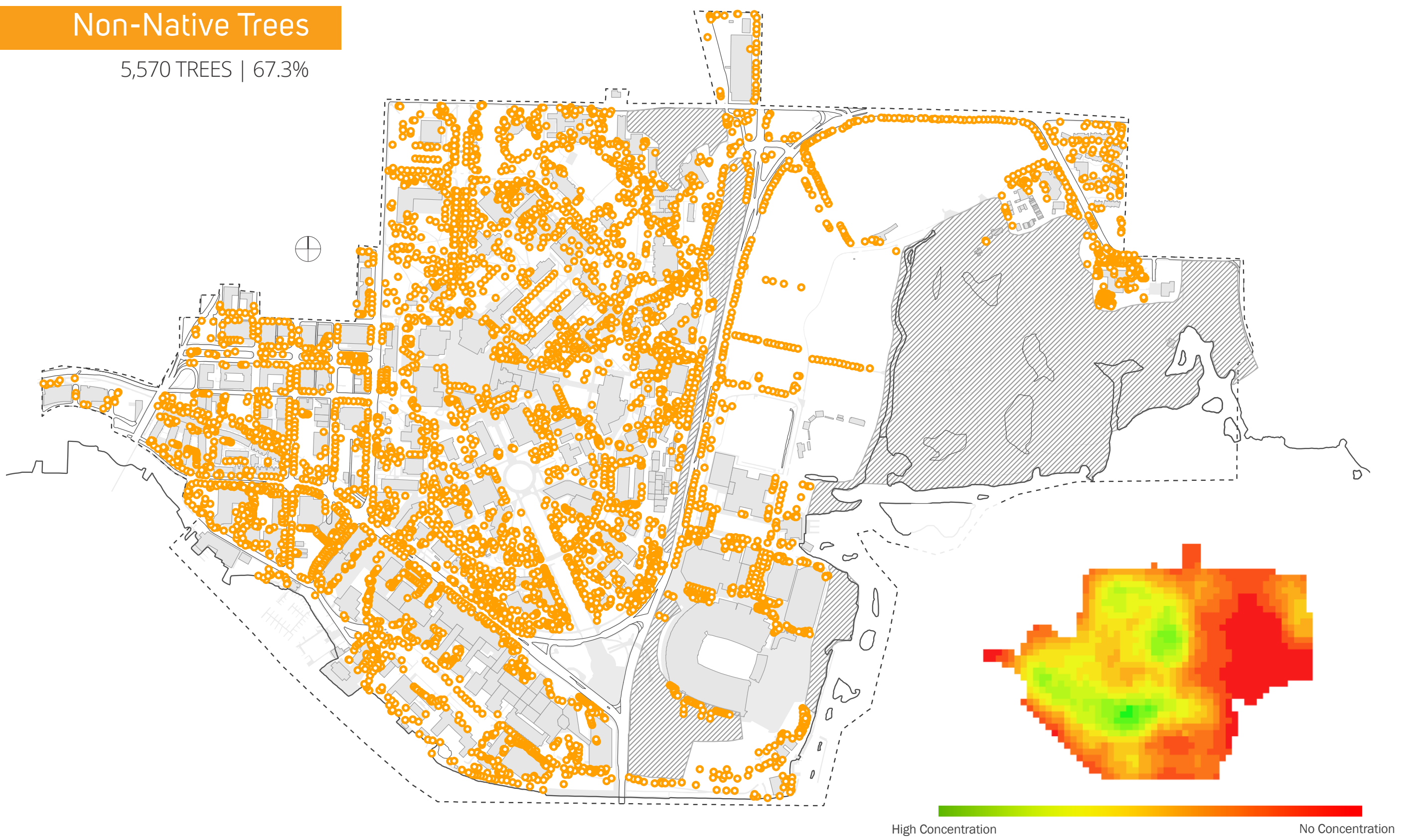
Native Trees

2,704 TREES | 32.7%



Non-Native Trees

5,570 TREES | 67.3%



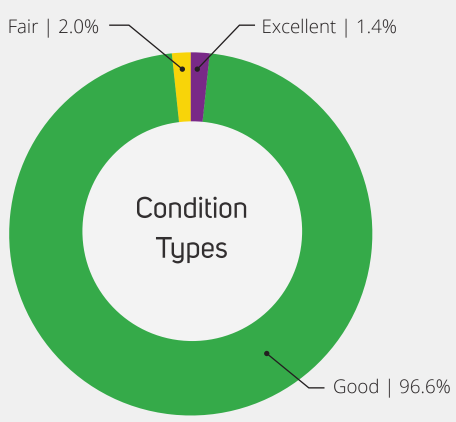
Coniferous Trees

2,458 TREES | 82 SPECIES

Historically, Washington was dominated by conifer forests that were logged extensively and what remains are scattered patches of old-growth forests across Western Washington. This has impacted the natural succession of Washington's forest that are now dominated by deciduous trees. Currently, Seattle has only 11% of its urban forest as coniferous while the University's urban forest consist of almost 20% conifers. Five of the top ten most prevalent species on campus are conifers with the highest densities of conifers being along the edges of central campus. Conifers are unique in that they provide environmental services all year long; improve air quality, provide wind & noise barriers, provide shade, and help retain stormwater runoff caused by impervious surfaces. Leveraging the environmental services offered by conifers could help the university protect areas from prevailing winds, shade buildings to reduce energy costs, and help manage stormwater on-site. One thing to note is that native varieties of conifers on campus are of a higher value than non-natives which could be the result of them being healthier due to their natural acclimation to the local ecology.

76.4%
Average Condition Rating

19.7%
of Total Trees on Campus

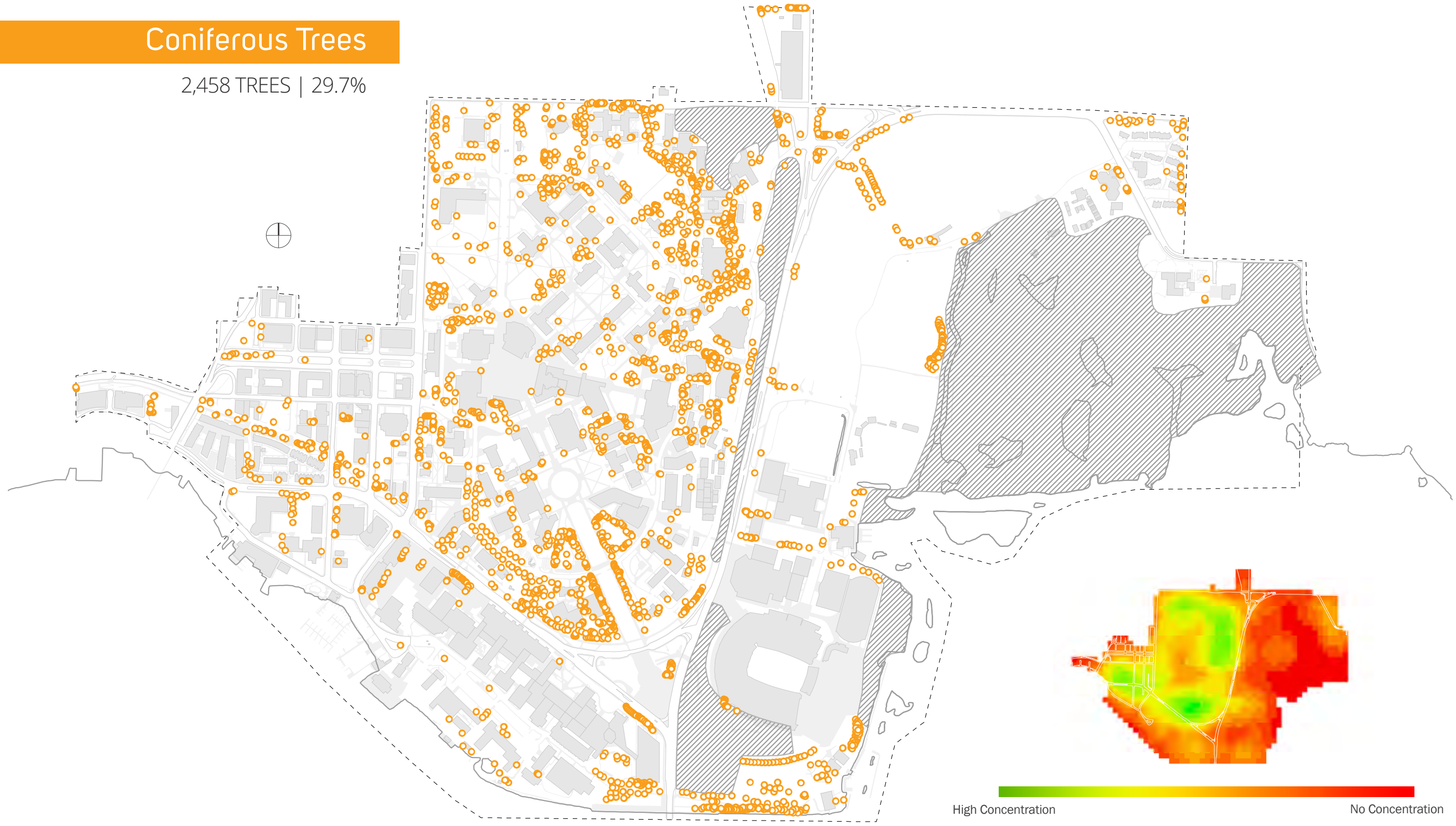


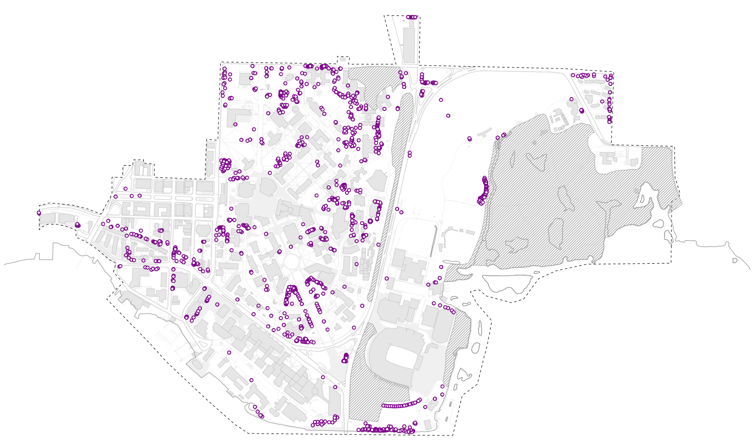
Most Common Coniferous Species

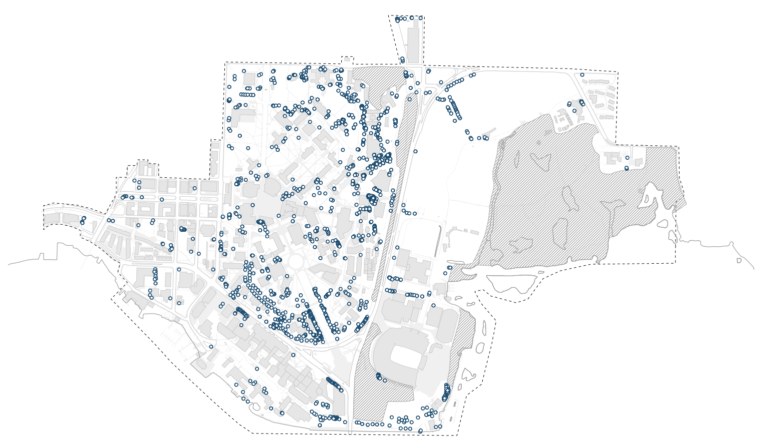
Tree Species	# of Trees	Average Condition Rating
Pseudotsuga menziesii	*448*	*78.72%*
Chamaecyparis lawsoniana	*264*	*74.52%*
Pinus sylvestris	*199*	*73.34%*
Thuja plicata	*199*	*78.56%*
Calocedrus decurrens	*156*	*77.81%*
Cedrus deodara	*142*	*76.78%*
Pinus contorta	*120*	*72.42%*
Thuja plicata 'Zebrina'	*76*	*75.16%*
Pinus nigra	*75*	*72.84%*
Tsuga heterophylla	*69*	*88.28%*

Coniferous Trees

2,458 TREES | 29.7%







Native Conifers

1,137 TREES | $8,051,700

Non-Native Conifers

1,321 TREES | $5,706,440

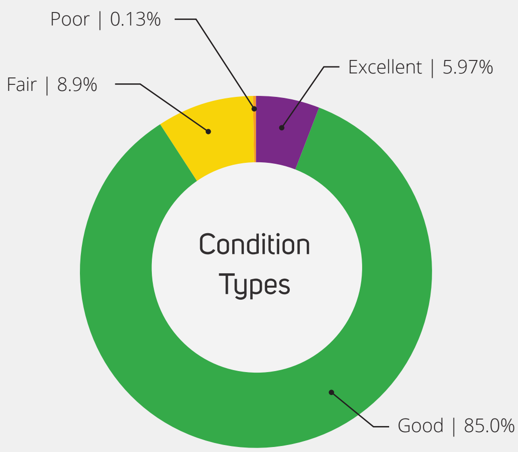
Deciduous Trees

5,420 TREES | 303 SPECIES

The amazing Fall color that is offered by Northwest deciduous trees is a cultural legacy that is celebrated by residents and visitors with trips to Northwest forested landscapes throughout the year. The majority of this region's old-growth forest has been replaced with deciduous trees that vary in their ability to produce food, flowers, and other resources. Strategically locating deciduous trees on the south and west side of buildings, around open space, and along critical areas can help create micro-climates to reduce energy costs, stabilize slopes, and provide shade. With 303 different species planted on campus, the University has a vast living resource that reflects the robust and diverse community that work, live, play, and study within the campus. A limitation of deciduous trees is that they provide half the stormwater management value that conifers offers because they are dormant during Seattle's wet/cold months. Populus tremuloides (Quacking Aspen) is a unique deciduous tree species because it has the ability to photosynthesize during the winter when other deciduous trees are dormant.

75.47%
Average Condition Rating

65.5%
of Total Trees on Campus

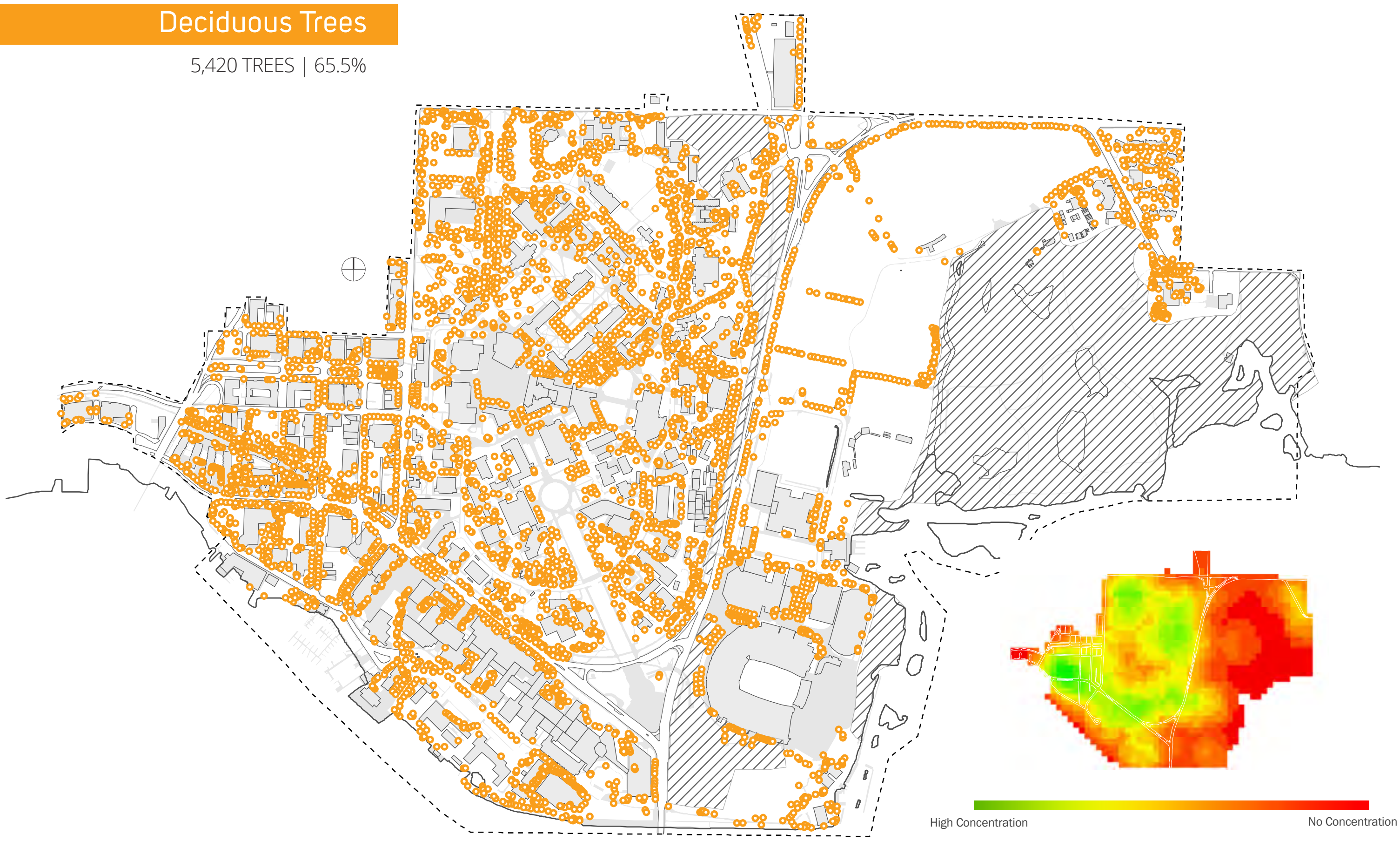


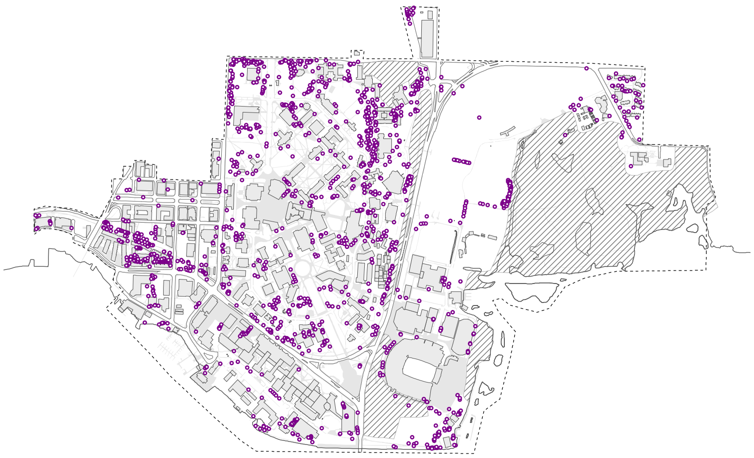
Most Common Deciduous Species

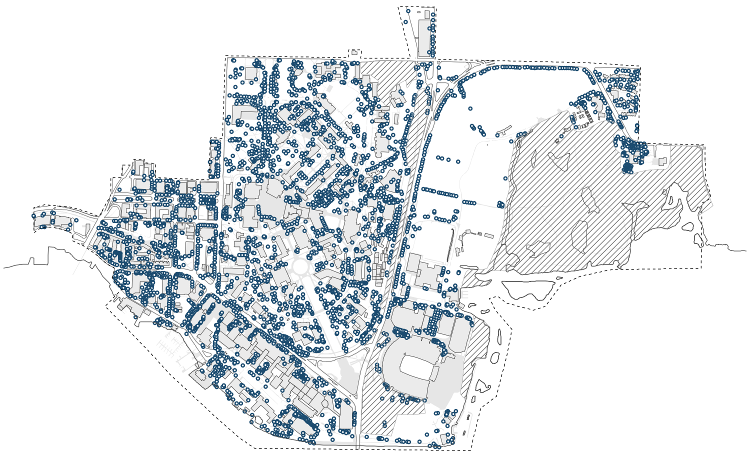
Tree Species	# of Trees	Average Condition Rating
Acer macrophyllum	396	70.69%
Acer circinatum	305	79.88%
Quercus rubra	195	75.54%
Acer rubrum	162	73.13%
Platanus x acerifolia	152	69.52%
Quercus palustris	139	75.47%
Carpinus betulus 'Fastigiata'	131	78.80%
Betula pendula	129	73.66%
Liriodendron tulipifera	122	74.55%
Acer palmatum	94	75.34%

Deciduous Trees

5,420 TREES | 65.5%







Native Deciduous

1,420 TREES | $5,498,930

Non-Native Deciduous

4,000 TREES | $14,906,485

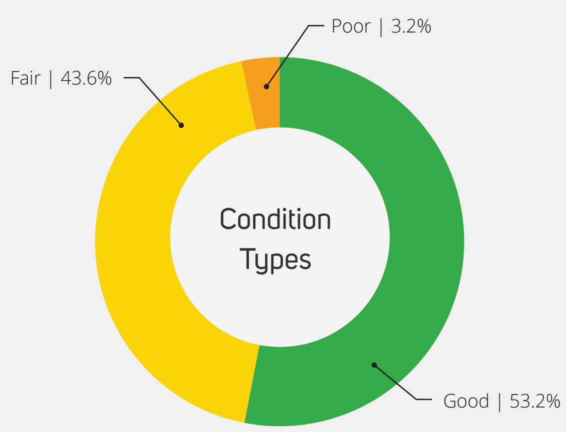
Broadleaf Evergreens

282 TREES | 26 SPECIES

Broadleaf Evergreens are trees or shrubs that have broad rather than needle like scaled leaves and maintain their leaves through out the year. They offer the color and fruit production of a deciduous tree while providing shade and canopy cover year-around. Shrubs can also be classified as a broadleaf evergreen with the state flower the Rhododendron being one example. One thing to note is that the most prevalent trees of this classification, Arbutus menziesii or the Pacific Madrona also have one of the lowest condition ratings. Both broadleaf evergreen trees and shrubs are susceptible to winter burn or desiccation caused by freezing temperatures which causes the plant to be unable to draw moisture from the frozen soil. With only 282 tree specimens and Madrona or "Arbutus mensiesii" representing almost 50% of the total, the University can grow this resource by increasing the number of types and specimens on campus. A challenge to increasing the diversity of Broadleaf Evergreens, like other tree varieities are favorable site conditions along with availability at local nurseries.

69.42%
AVERAGE CONDITION RATING

3.4%
of Total Trees on Campus

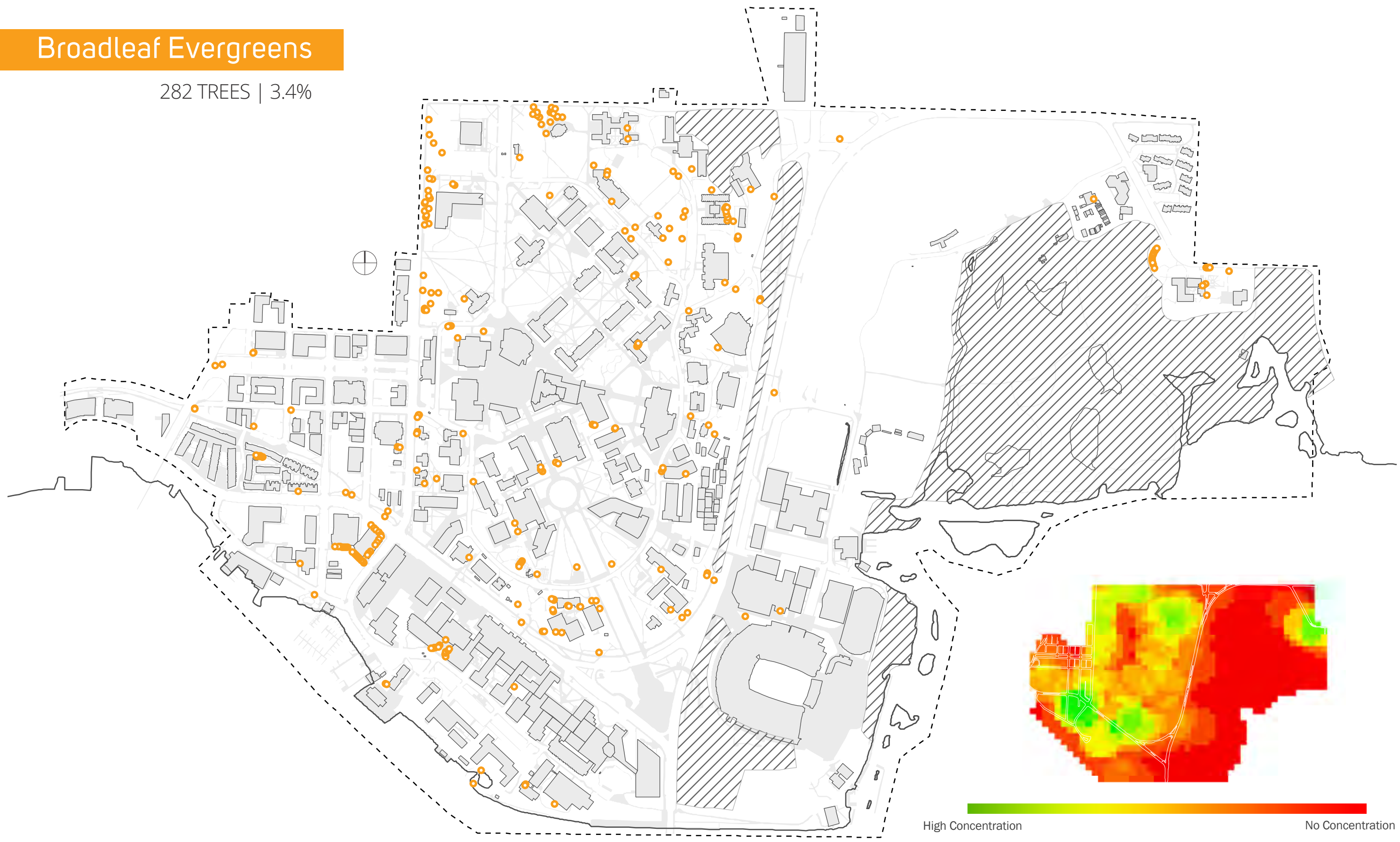


Most Common Broadleaf Evergreen Species

Tree Species	# of Trees	Average Condition Rating
Arbutus menziesii	*103*	*65.50%*
Arbutus unedo	*22*	*78.77%*
Laurus nobilis	*21*	*73.62%*
Eucalyptus sp	*20*	*69.35%*
Ilex aquifolium	*19*	*75.11%*
Umbellularia californica	*14*	*74.21%*
Ilex 'September Gem'	*11*	*77.00%*
Nothofagus antarctica	*8*	*72.38%*
Podocarpus macrophyllus	*8*	*68.88%*
Acacia melanoxylon	*8*	*32.88%*

Broadleaf Evergreens

282 TREES | 3.4%



Native Broadleaf Evergreens

147 TREES | $510,670

Non-Native Broadleaf Evergreens

135 TREES | $183,660

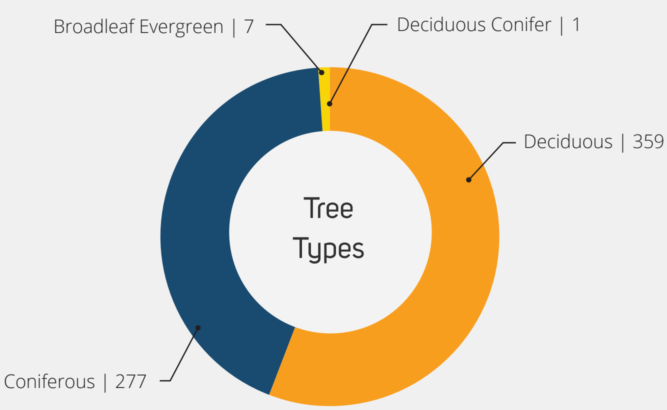
Exceptional Trees

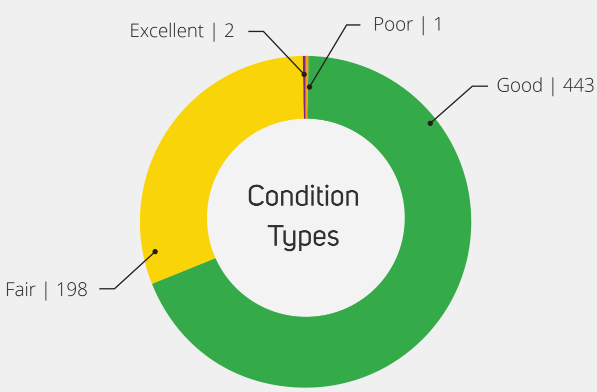
644 TREES | 70 SPECIES

Exceptional Trees provide the University with culturally significant specimens that offer educational opportunities, habitat benefits, and enhance the overall quality of the University. These trees have been identified based on the City of Seattle's Director Rule 16-2008 that defines an exceptional tree as one that:

"because of its unique historical, ecological, or aesthetic value constitutes an important community resource"

There are two primary thresholds that the university uses in defining which trees on campus are considered exceptional or not. A DBH of 30" or greater, or meets and/or exceeds the threshold diameters specified by the Director's rule for specific tree species with a threshold below 30". There is an additional threshold associated with grooves of trees that the University does not use because it would classify the majority of trees on campus as exceptional.



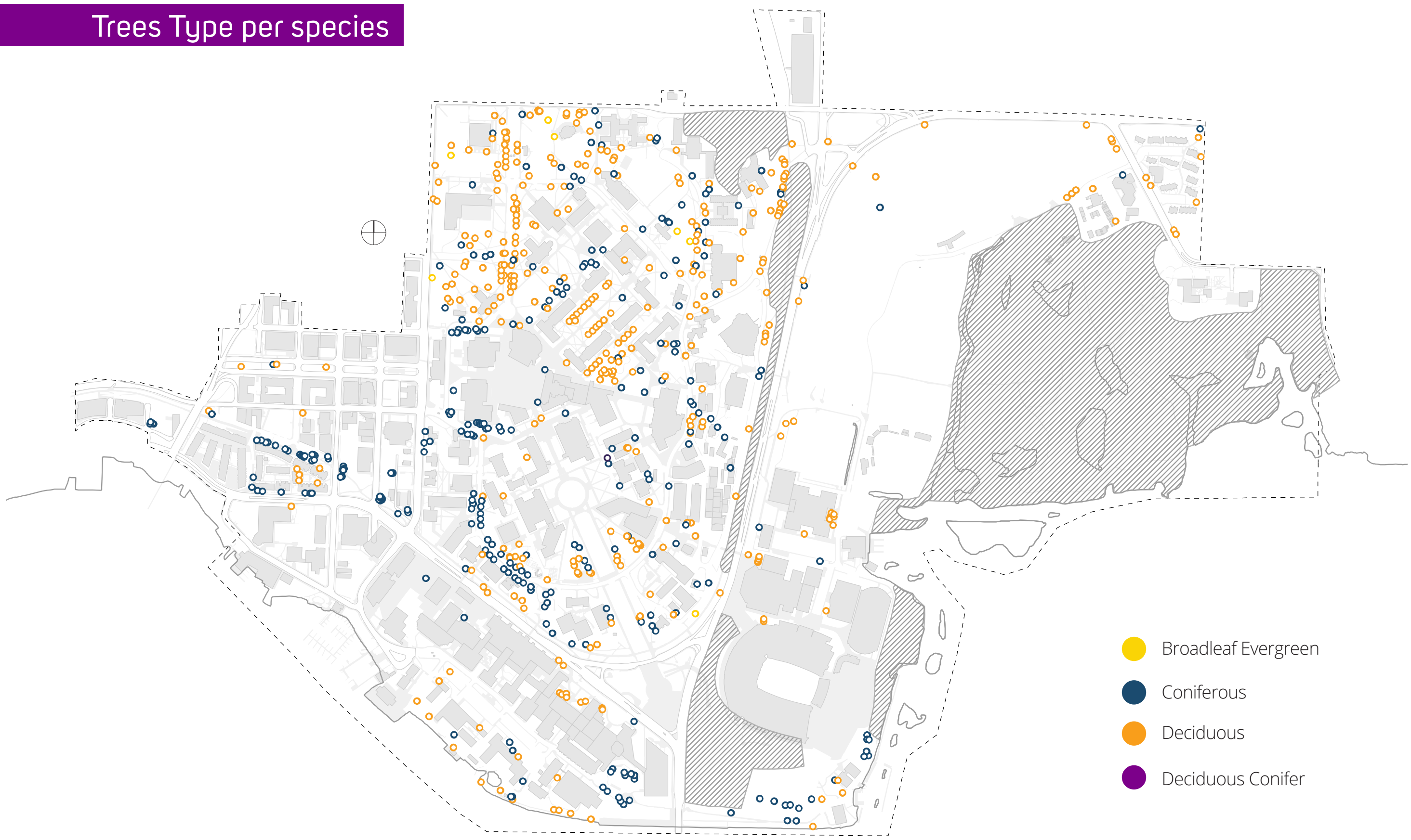


Most Common Exceptional Trees

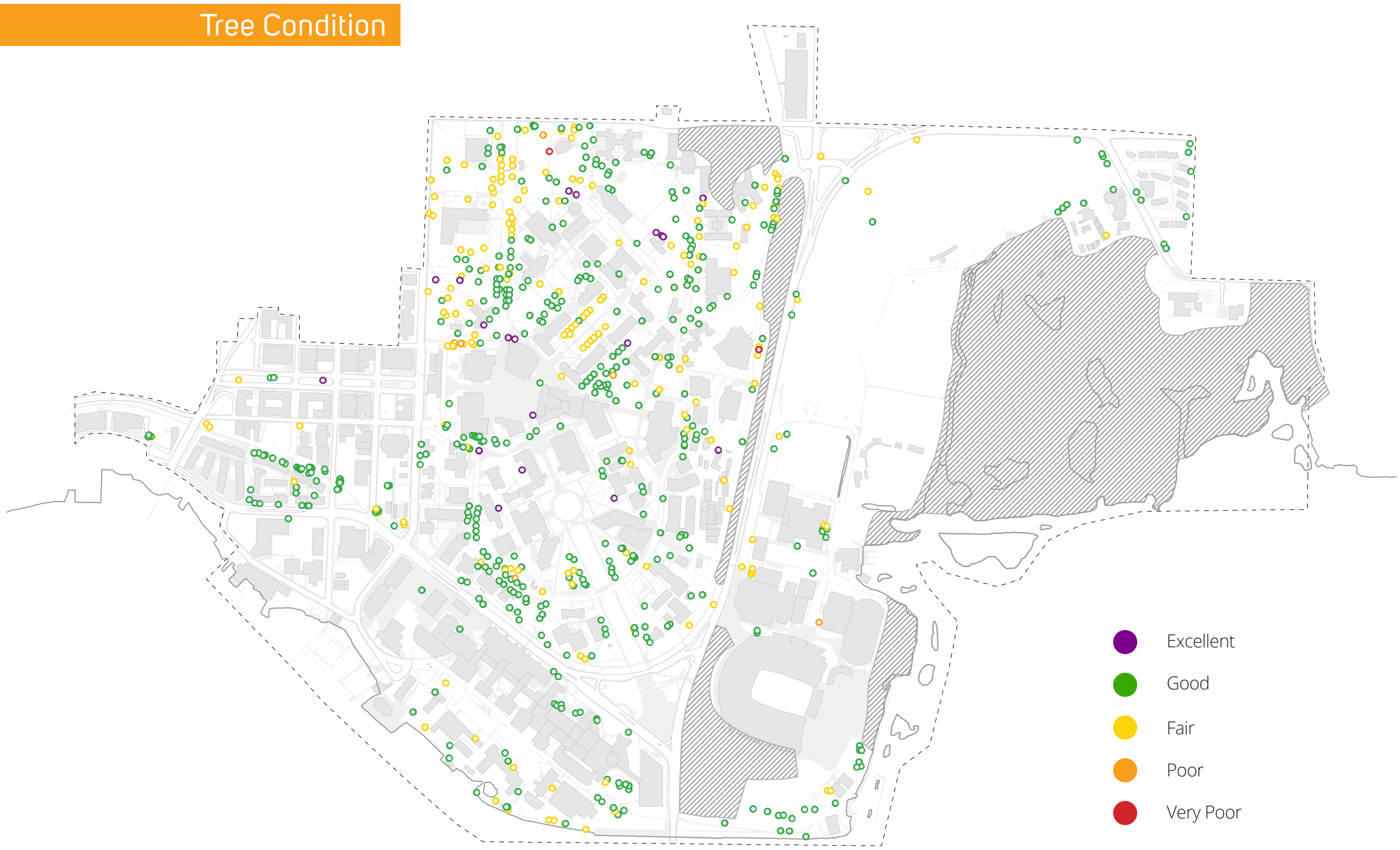
Tree Species	# of Trees	Average Condition Rating
Pinus contorta	*106*	*71.72%*
Acer macrophyllum	*60*	*67.30%*
Cedrus deodara	*57*	*77.16%*
Pseudotsuga menziesii	*50*	*75.40%*
Platanus x acerifolia	*44*	*69.91%*
Cornus nuttallii	*30*	*69.40%*
Acer circinatum	*24*	*70.13%*
Aesculus hippocastanum	*22*	*77.18%*
Prunus x yedoensis	*17*	*66.65%*
Carpinus betulus 'Fastigiata'	*17*	*80.06%*

** This does not include Exceptional trees as part of grooves and trees 75% the size of the largest documented trees*

Trees Type per species



Tree Condition



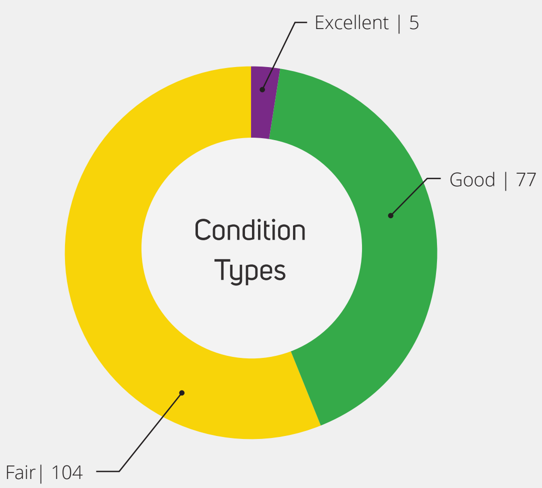
Memorial Trees

186 TREES | 30 SPECIES

Following major events in history, the University has completed multiple tree plantings on campus to honor students, veterans, professors, and faculty associated with these events. In addition, individuals are able to purchase a memorial tree for a loved one or colleague that is maintained in perpetuity by UW Grounds Management and showcased on a Memorial Tree map that can be found online. A short list of memorial plantings of interest are the allee of London Plane (Platanus x acerifolia) trees that line Memorial Way to honor the 58 students that died in World War I, Douglas Firs (Pseudotsugo menzieseii) for Jewish Arbor Day, and the Giant Dogwoods (Cornus controversa) that honor 911 victims. The trees on campus not only represent the amazing ecology of the northwest but also provide moments to reflect and honor veterans, and influential faculty that have left a cultural or social impact on the UW community and society. The continued promotion and expansion of this resource can help increase the awareness of the multiple layers of value and significance that many campus trees possess.

72.59%
Average Condition Rating

44
Exceptional Trees

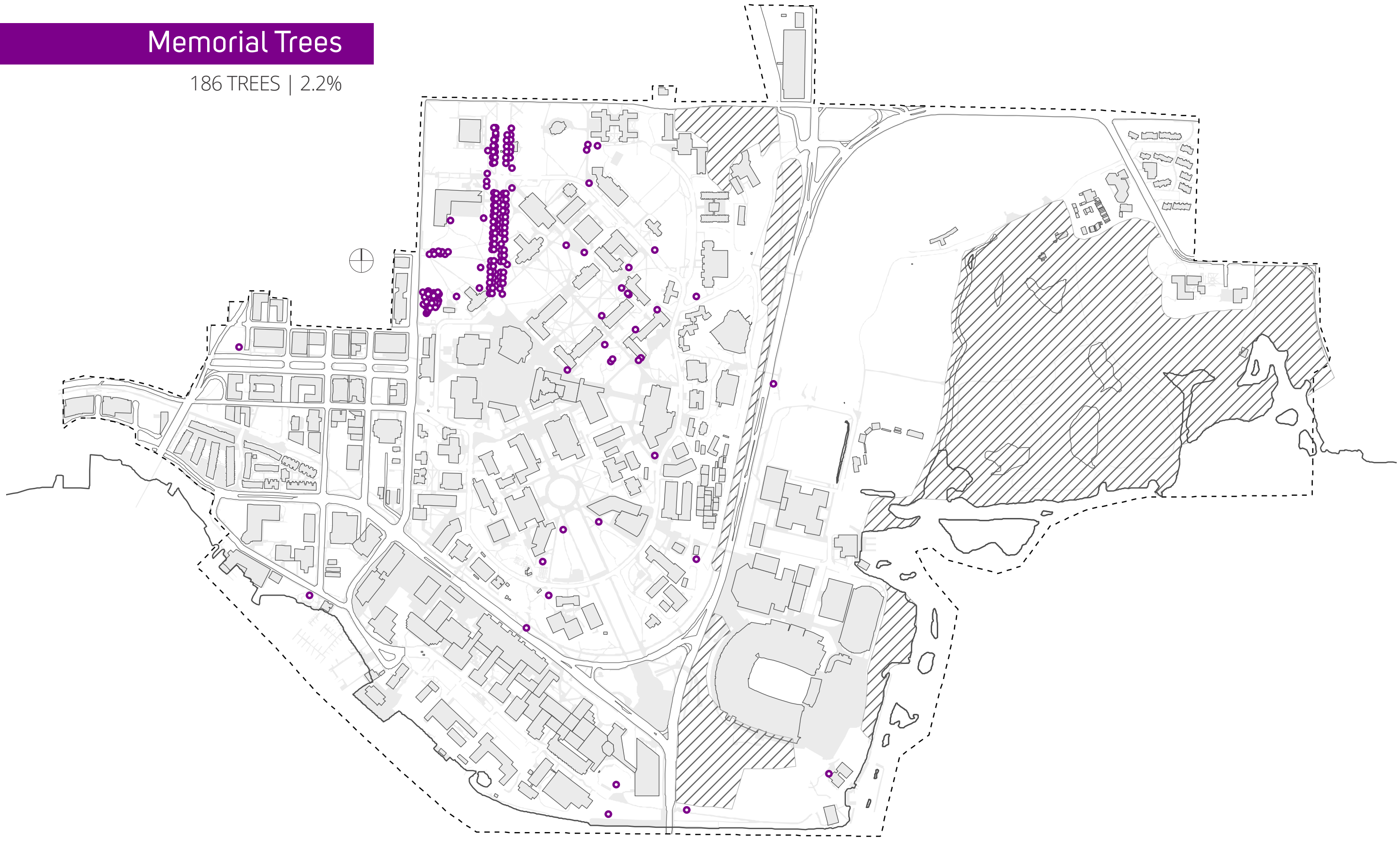


Most Common Memorial Trees

Tree Species	# of Trees	Average Condition Rating
Platanus x acerifolia	*99*	*69.17%*
Pseudotsuga menziesii	*36*	*83.61%*
Quercus coccinea	*9*	*82.22%*
Thuja plicata	*5*	*82.80%*
Cornus controversa	*3*	*80.00%*
Davidia involucrata	*3*	*81.00%*
Malus sp	*3*	*83.67%*
Prunus subhirtella	*2*	*55.50%*
Sequoiadendron giganteum	*2*	*78.50%*
Cornus kousa	*2*	*77.00%*

Memorial Trees

186 TREES | 2.2%



TREE DEDICATIONS

Major Events

911 Victims

Armistice day, 1920

58 students who died WW1

Jewish Arbor Day

In Honor of.....

Annie Knight

Ben Athay, 2007

Bill Talley, 2007

Bob Anderson Memorial Tree

Charles "Griz" Graves

Chris Holmer and the Holmer family

Class of 2007

David Ogrodnik, 2013

Eugene G. Goforth, MD 1975

Holly Turner

Honor of Staff member Baby

In memory of an employee by fellows

Jill M Nakawatase

Laurence Walters Family

Lynn Guggenheim 1997

Lynns Tree

Mark Nelson

Martin Elder

Phil Johnson "UW Gardener"

Sigma Kappa Centennial Memorial Tree

UW Graduate John Messier

Walt Gordon

William Bergsma, UW School of Music Director, 1963-1971

Unique Trees

"Meany Sequoia" planted by Edmond S. Meany

"The Miller Elm" for Francis G. Miller

Meany Oak

"Washington Elm" - George & Martha Holly

Centenneal Cedar by Mary Gates Hall

Special Trees

PINACEAE | SAPINDACEAE | CUPRESSACEAE | ROSACEAE

The University of Washington adds to the value of its urban forest by planting rare Northwest trees on campus that are curated as a campus tree tour in honor of Professor Frank Brockman, an influential professor in Forestry who created the first university tree tour in 1980. The University takes pride in utilizing the landscape as an educational resource by designing it as an extension of the classroom. Rare trees on campus have been identified using the book, "Trees of Seattle" by Arthur Lee Jacobsen, a local tree guide that identifies mature healthy examples of each unique tree specie in the city. The Brockman Memorial Tree Tour currently consists of 66 trees that highlights the beauty and diversity of trees on campus through an online available tour with a printable map for those who would like to experience the trees on site. One thing to note is the below average condition of rare trees compared to the memorial trees. This shows that rare trees might require additional maintenance to be kept at excellent health compared to other, more common Northwest species.

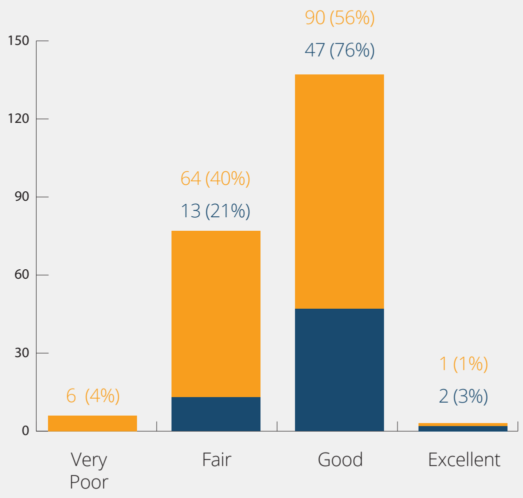
68.69%

Average Rare Tree Condition

73.79%

Average Memorial Tree Condition

SPECIAL TREE CONDITION

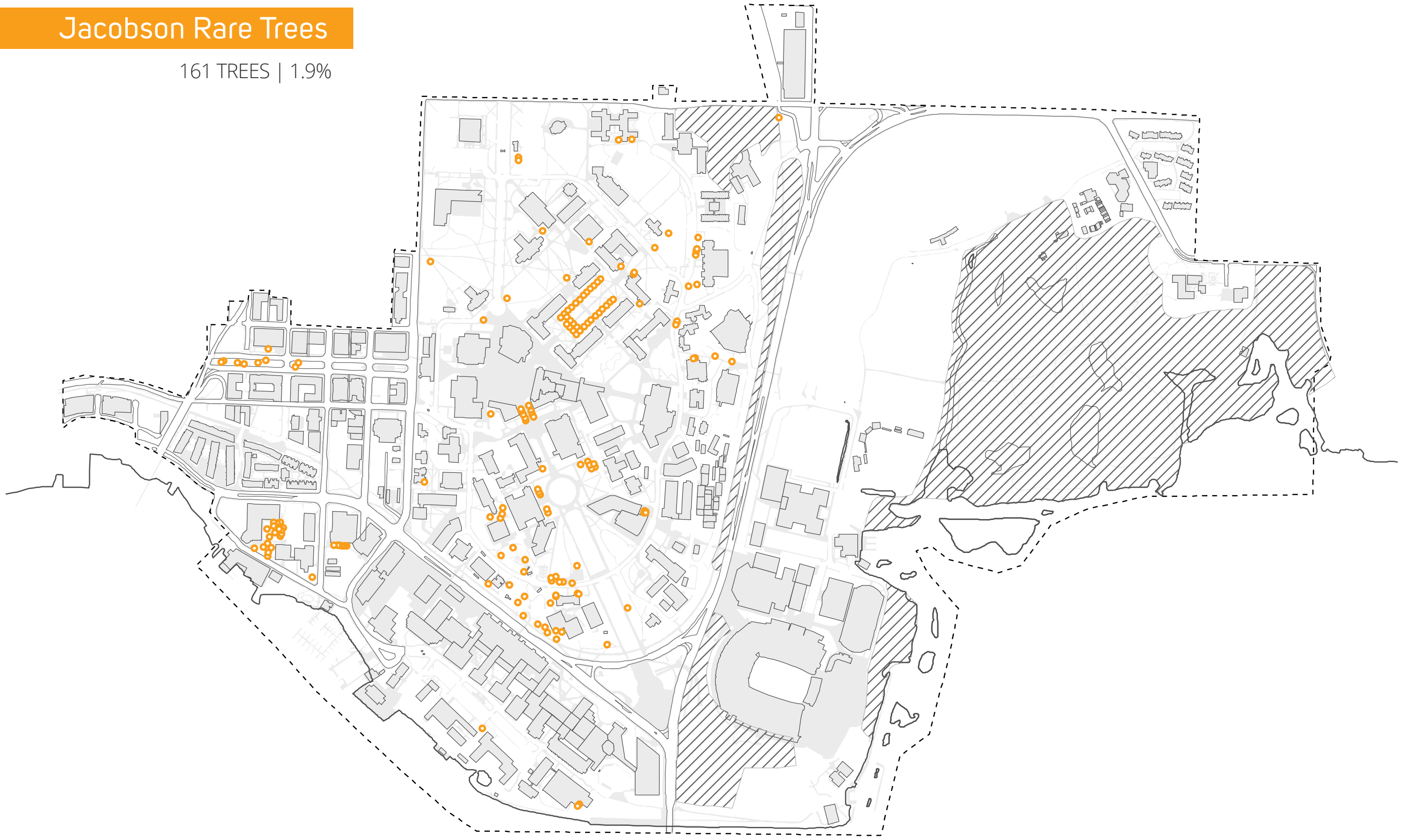


Most Common Jacobson Rare Trees

Tree Species	# of Trees	Condition Rating
Prunus x yedoensis	*30*	*66.97%*
Idesia polycarpa	*19*	*64.89%*
Prunus serrulata 'Hisakura'	*9*	*71.00%*
Pinus coulteri	*8*	*70.50%*
Malus baccata	*7*	*74.14%*
Acacia melanoxylon	*7*	*29.43%*
Carpinus japonica	*5*	*67.00%*
Crataegus pruinosa	*5*	*72.20%*
Tilia cordata	*5*	*70.40%*
Chamaecyparis pisifera	*4*	*77.00%*

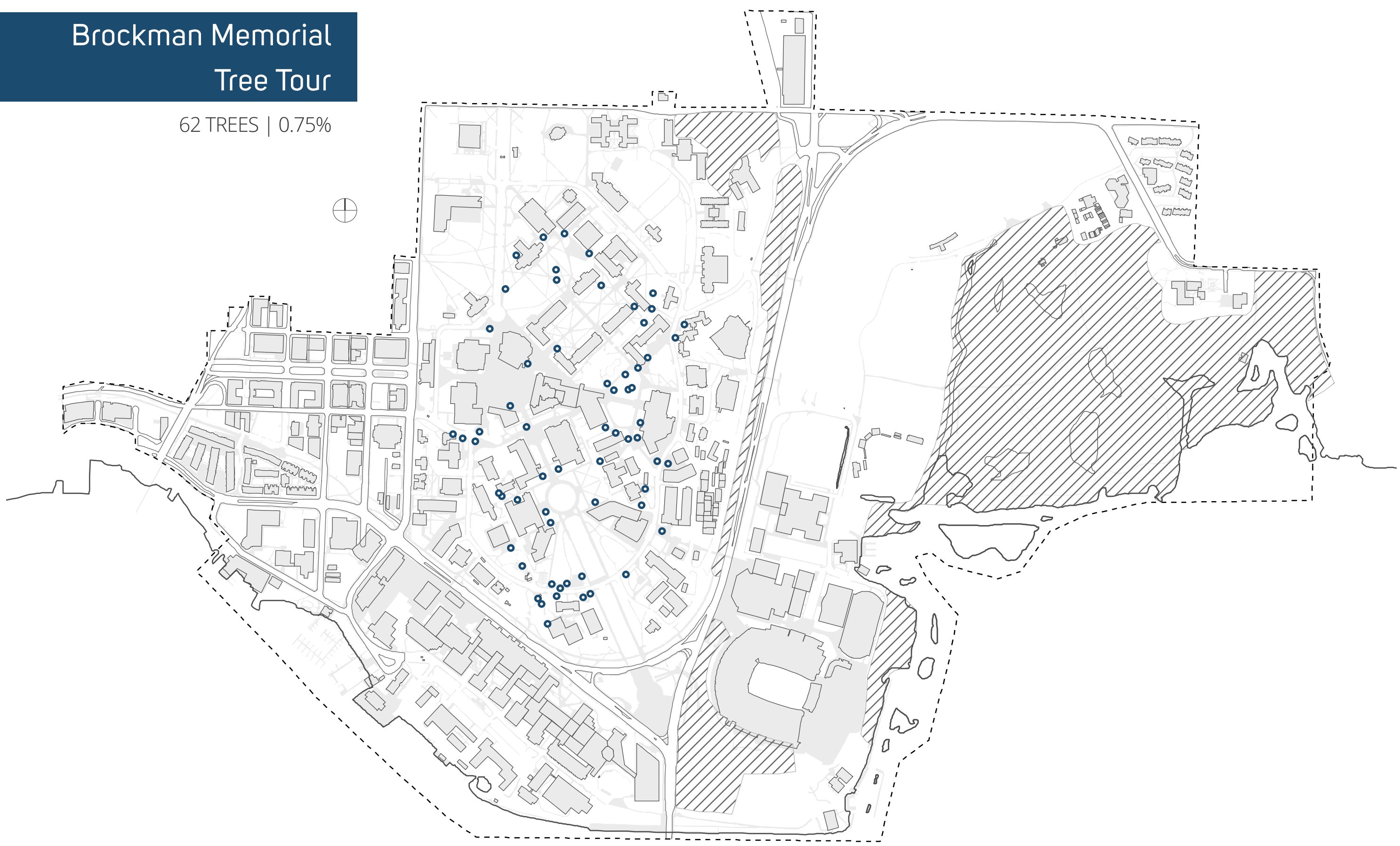
Jacobson Rare Trees

161 TREES | 1.9%



Brockman Memorial Tree Tour

62 TREES | 0.75%



Disease Susceptibility

INTEGRATED PEST MANAGEMENT | INOCULATION

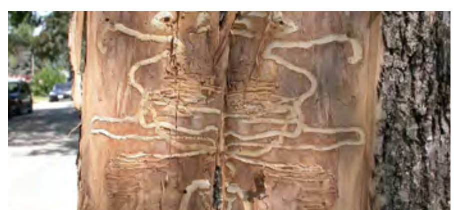
All trees are susceptible to disease or insects, it's the fatal nature of their susceptibility that varies. The best way to protect a tree from harmful agents is to plant them in an ideal condition and maintain them to optimal health. Though not all disease or insects only attack unhealthy trees. Emerald Ash Borer, Dutch Elm, and Chestnut Blight attack trees of all conditions. Planting a diverse stand that is not limited to natives is ideal because many diseases and insects affect native plants. A ratio of no more than 10% of one species or 20% of one genus or 30% of one family is recommended to minimize the risk of massive disease infestation resulting in large volumes of tree death. Currently, the University is below these thresholds.

With the number of outbreaks growing, a diversity of trees need to be maintained in the urban environment to better protect the forest from a single vector destroying the canopy. Urban areas that have a concentration of individual species are more susceptible to a massive infestation. When establishing a tree palette for an area, it is not recommended to limit tree types to ones that are not associated with a major disease or insect risk, unless there have been high volumes of outbreaks. Overly restricting tree choices will put areas at risk of potential outbreaks caused by future unknown pests.

When a tree has been identified as potentially infected or diseased the University's Arborist conducts an evaluation of the tree using the University of Washington Tree Hazard Evaluation Form. This form helps the University determine the necessary means for resolving the hazard. A tree is removed when pruning, cabling, spraying, or injecting are not viable options for resolving the concern. The University takes advantage of integrated pest management to minimize its use of insecticides, fungicides, and pesticides because of their potential negative effects on soil biology, pollinators, water quality, and human health.


Dutch Elm Disease


Horse Chestnut Blight


Emerald Ash Borer


Bronze Birch Borer


Aphids


Spider Mite

Dutch Elm Disease

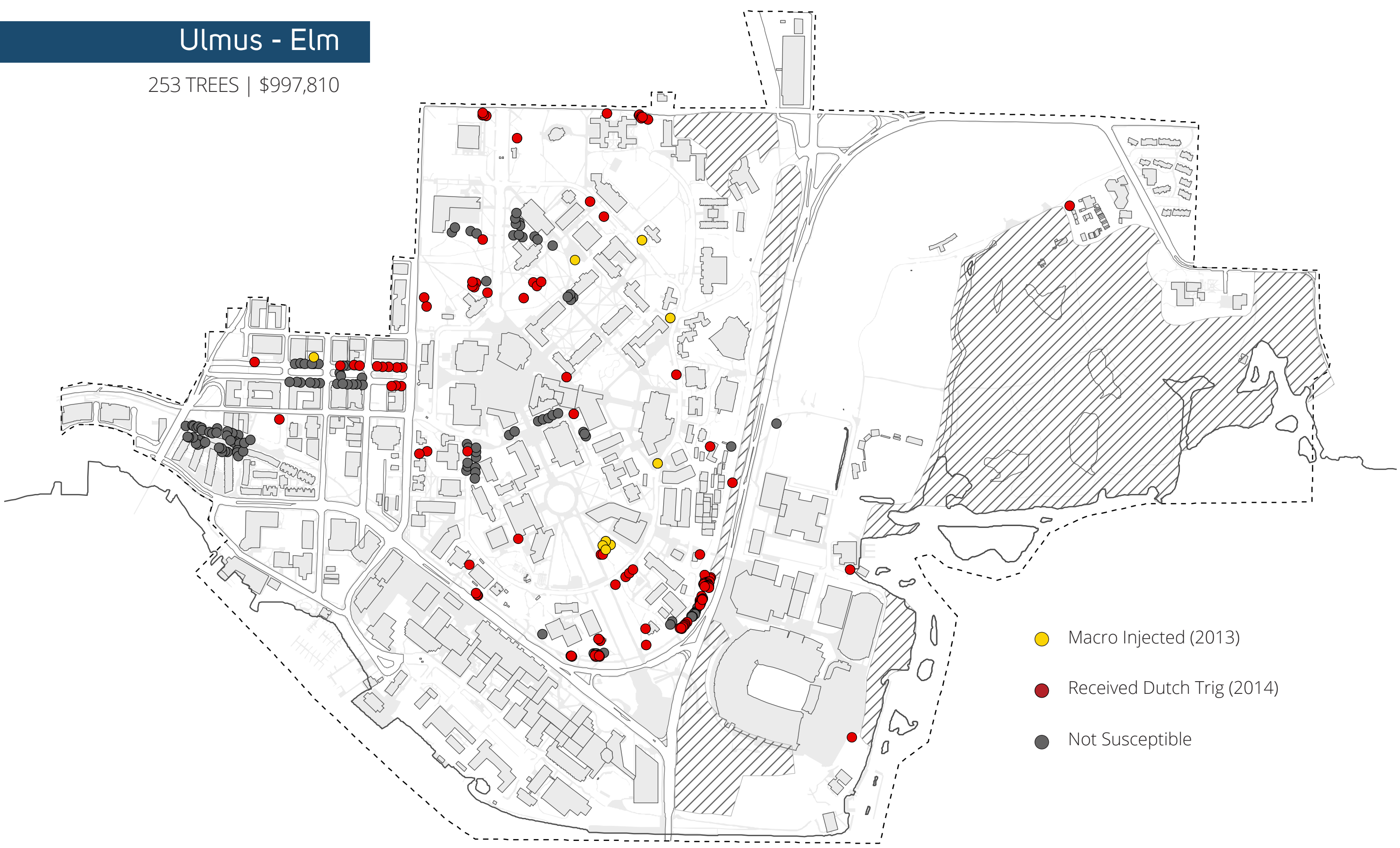
ULMUS | TREATMENT ON-GOING

Dutch Elm Disease is currently a problem on the University of Washington Seattle Campus with a number of trees having already died as a result of being infected by the Elm Bark beetle. The battle to save other Elms on campus is an on-going and difficult effort because of the beetle's mobility and the existence of a large number of suceptible elm varieties on campus and in the surrounding communities. Even if the University manages their trees to a high standard, neighboring properties can become infected which can spread onto campus. The Elm Bark Beetle has the ability to travel up-to 1,000 feet per flight and is prolific having four reproduction cycles per year.

Grounds Management staff has been trained to identify the pest along with signs of infestation to assist in early detection and eradication. As part of the university's management strategy, roughly 100 susecptible elms are innoculated with the "Dutch Trig" vaccine each year while the more significant Elm trees on campus are treated with a Arbotech Macroinjection every two years. The University will continue using early detection and rapid response paired with injections to minimize future tree loss while also specifing elm varieties that are less susceptible to the Dutch Elm for new plantings.

Ulmus - Elm

253 TREES | $997,810



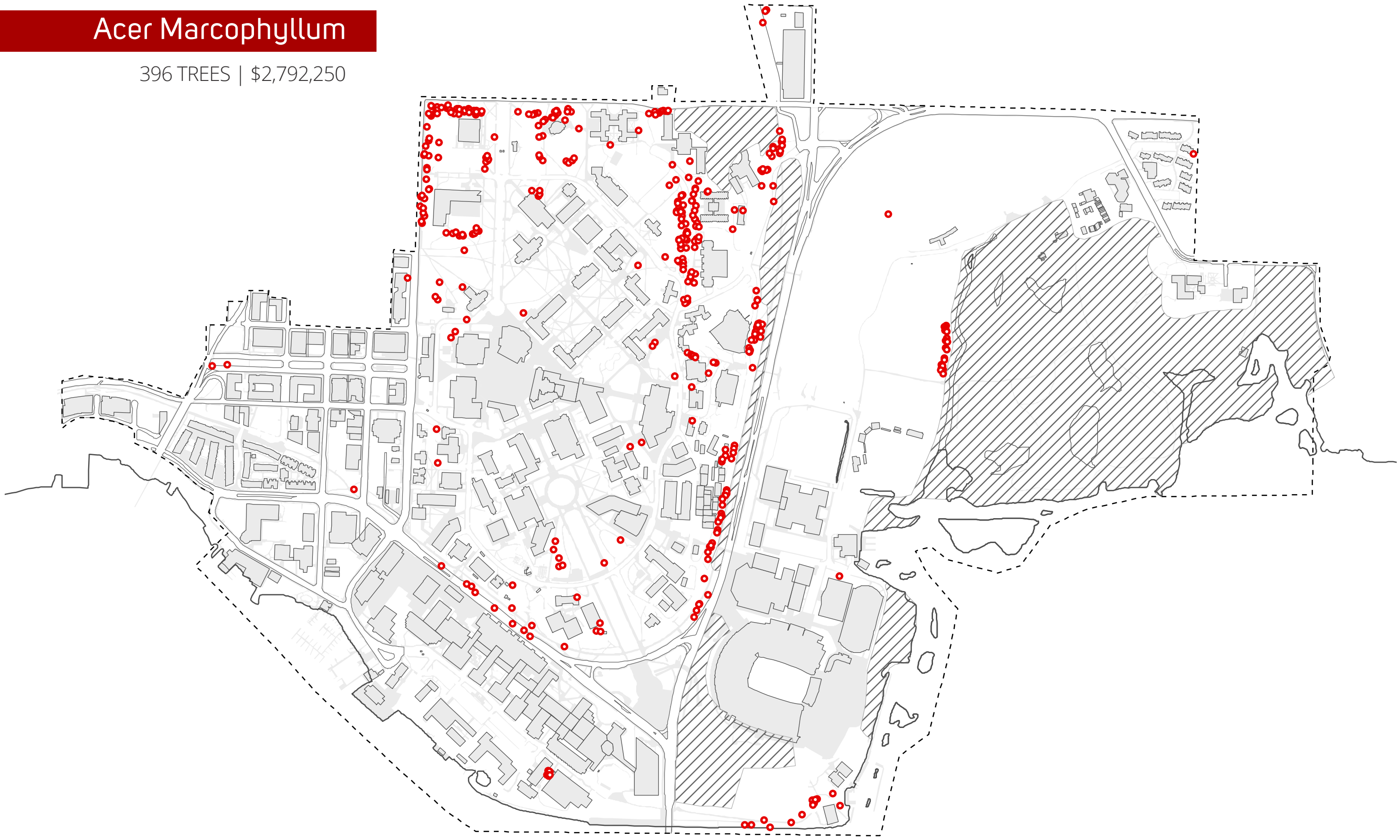
Verticillium Wilt

ACER | CURRENT PROBLEM

Verticillium is a soil-borne fungi that attacks woody ornamental trees in the United States. Verticillium slowly spreads inside the tree causing a slow and long death. Many times this infection is confused with other tree impacts: herbicide damage, adverse environmental conditions or mechanical damage. Nurseries using land that was previously growing infected plants are more susceptible to this disease. Certain trees are more susceptible to this disease while others are immune to Verticillium, like Beech, Birch, Pine and Polar. Currently, this disease has been infecting trees on campus, with the response being to immediately remove the tree and replace it with a different species. The map below shows the breath of Big Leaf Maples on campus which are highly susceptible to this disease.

Acer Marcophyllum

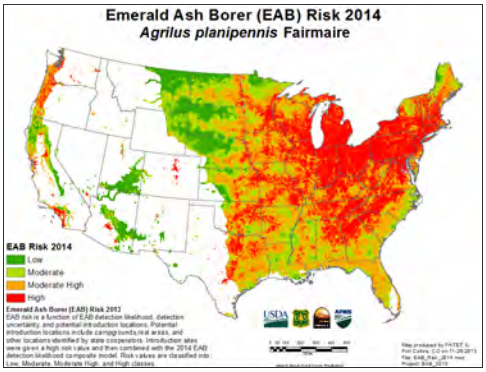
396 TREES | $2,792,250



Emerald Ash Borer

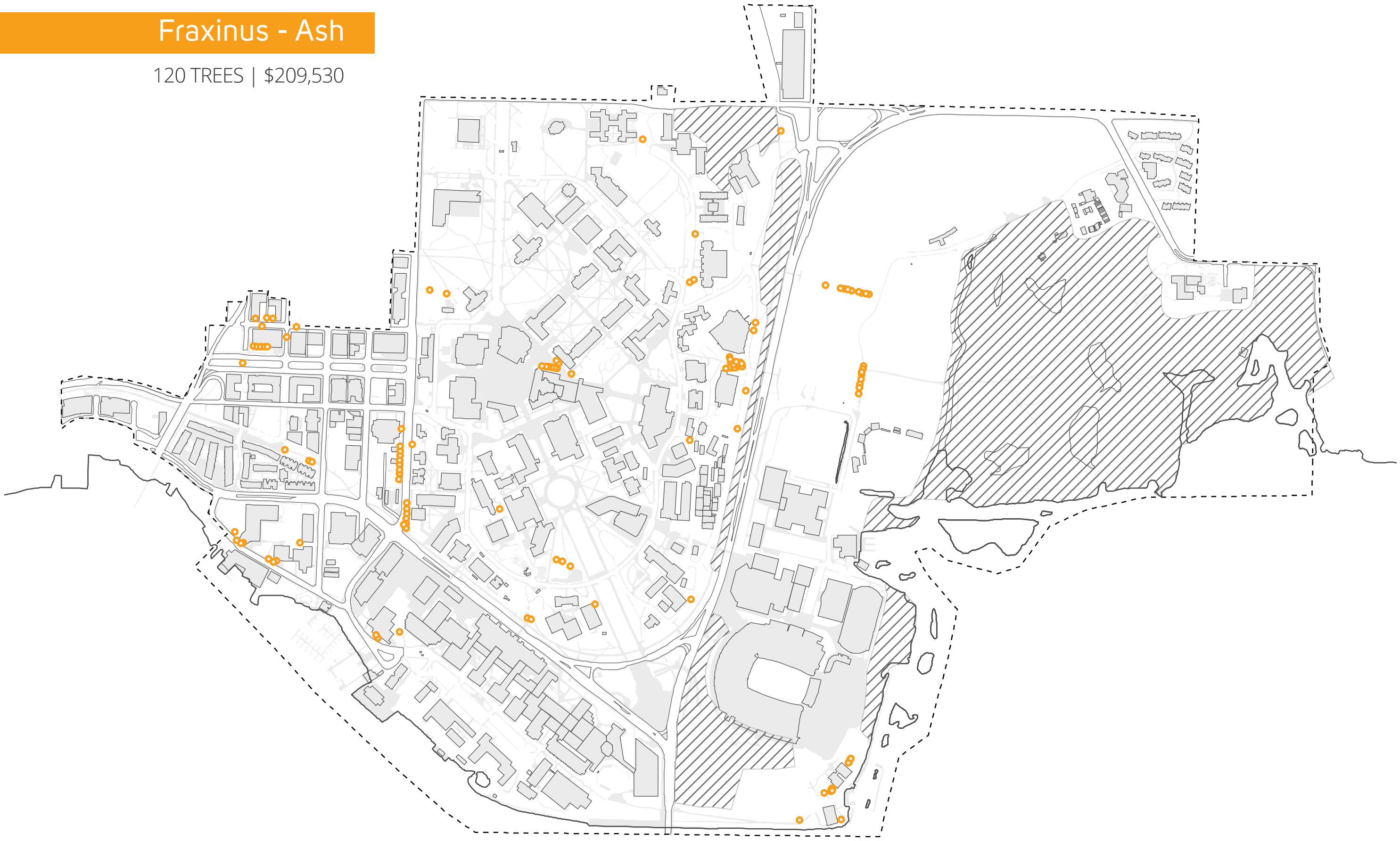
FRAXINUS | NO REPORTED CASES

Emerald Ash Borer is an invasive beetle that has yet to make its way into Washington State. The beetle feeds on the inner bark of ash trees negatively impacting the tree's ability to transport water and nutrients. The beetle is native to Asia and is assumed to have arrived to the US on solid wood packing materials. The areas where this beetle is being reported have implemented quarantines in an effort to restrict its movement. The Puget Sound Region has been identified by the USDA and US Forest Service as a high risk area for potential outbreaks because of the robust forest and associated industries that are in this region. Establishing an early detection rapid response strategy to help educate staff on properly identifying this diseases will aid in reducing any outbreaks that may occur.



Fraxinus - Ash

120 TREES | $209,530



Bronze Birch Borer

BETULA | NO CASES YET

The Bronze Birch Borer has yet to be found on campus, but has been established in the Portland area since 2000. The UW gardeners and arborist are on the watch for the black beetle because once infestation has started in a tree it is difficult to eradicate without the use of pesticides. The beetles are most attracted to unhealthy trees so by planting new Birch trees in their ideal habitat; cool areas with moist soil and partial sun exposure with minimal foot traffic will help minimize the risk of infestation. Also, selecting varieties that have greater resistance is also a good strategy for minimizing risk. It has been said that it is not a matter of if, but when this becomes an issue on campus so the University is taking the appropriate steps for establishing a early detection and rapid response strategy.

High Susceptibility

Betula pendula

Betula pendula 'Youngii'

Betula utilis var jacquemontii

Moderate Susceptibility

Betula papyrifera

Betula populifolia

Betula alleghaniensis

Minimal Susceptibility

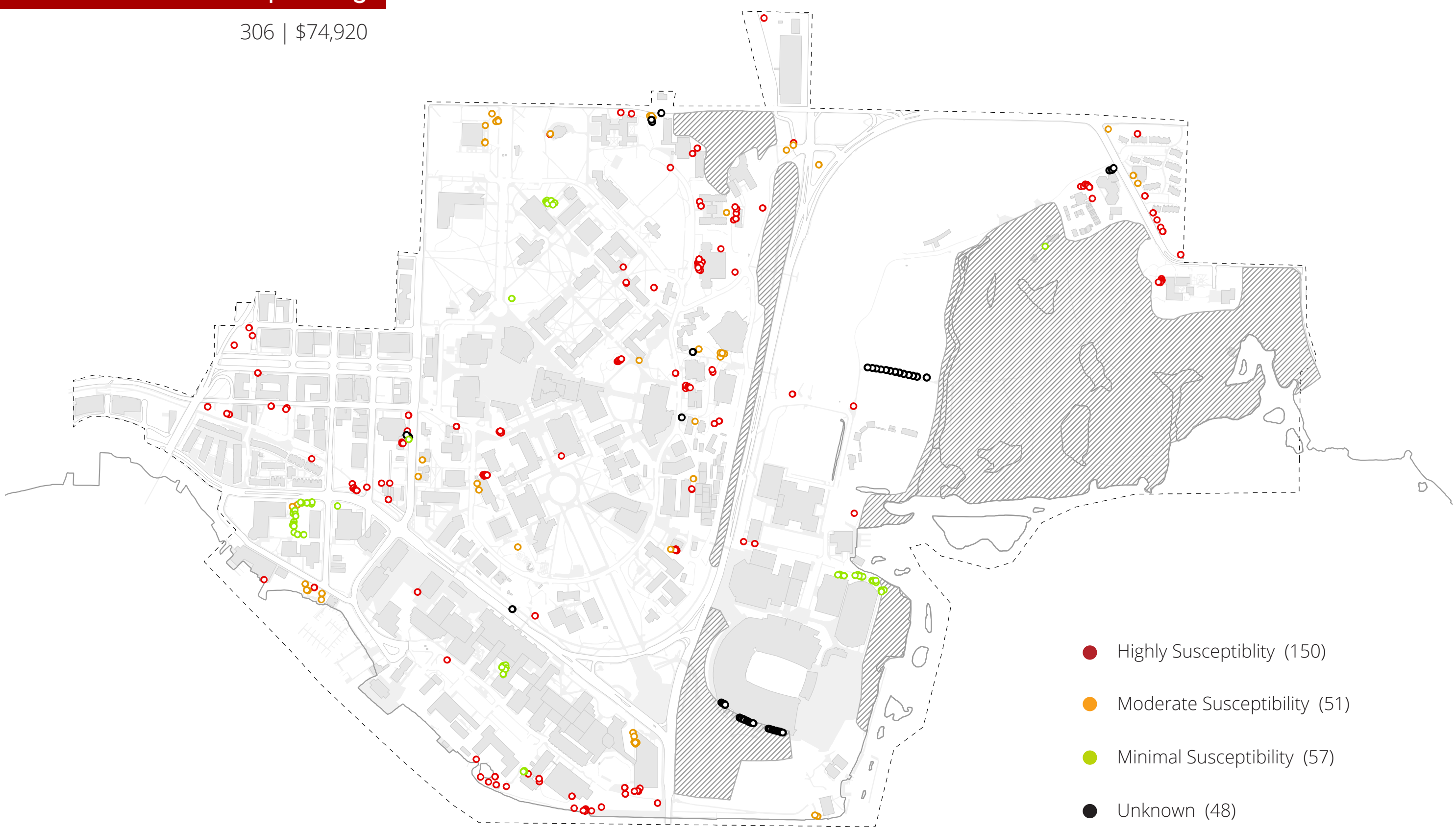
Betula nigra

Betula nigra 'Heritage'

Betula lenta

Betula Susceptibility

306 | $74,920



Invasive Species

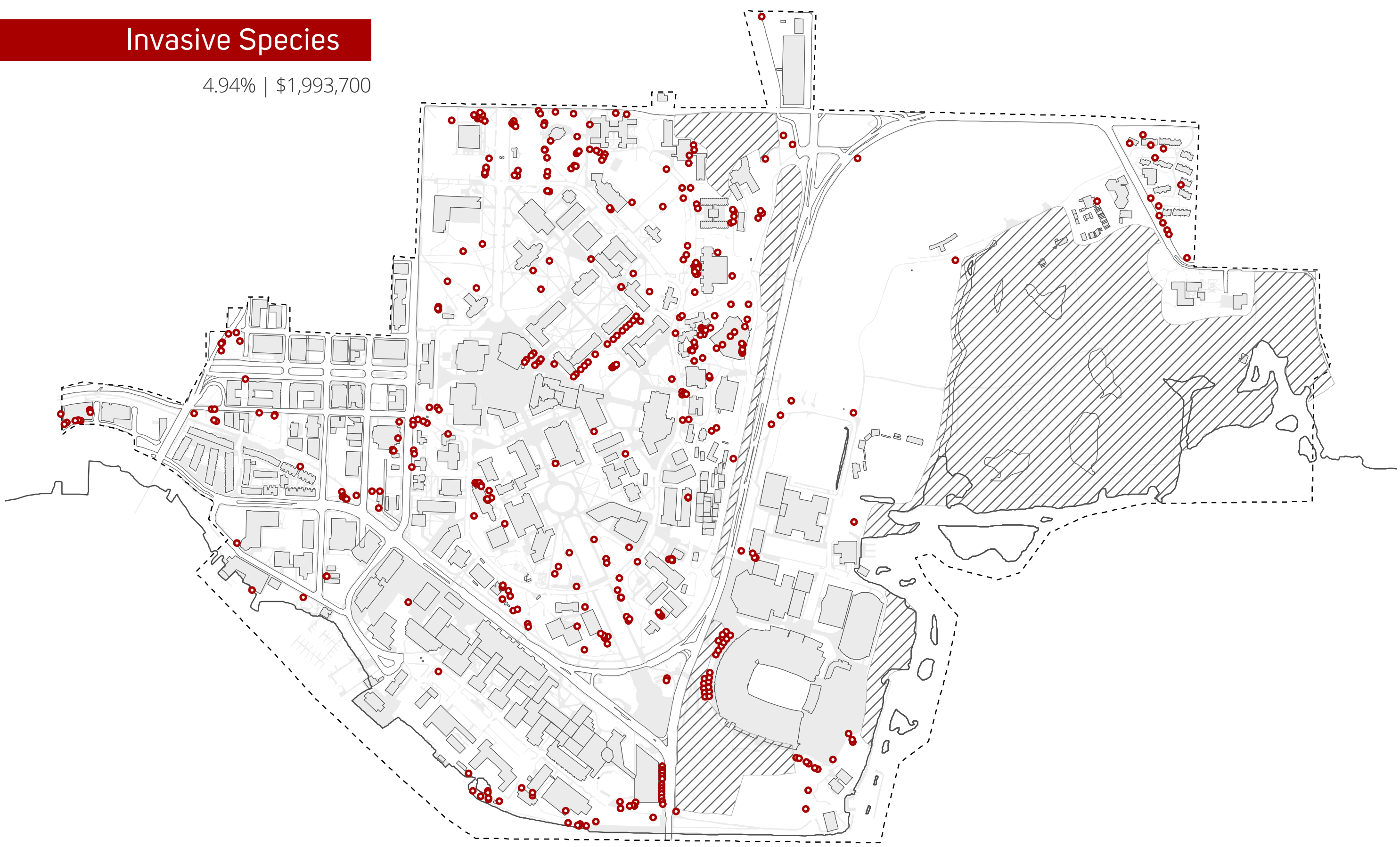
409 TREES | 12 SPECIES

The University has approximately 409 trees on campus that have been identified by the King County Noxious Weed Division as being invasive. These species have the potential to out compete diverse grooves of plants turning areas into a mono-culture of unwanted vegetation. A form of quarantine management is an potential strategy for minimizing their ability to out compete adjacent vegetation to preserve their presence on campus as an academic resource. The following species have been identified as invasive and are scattered across campus:

Norway maple – Acer platanoides
Horse chestnut – Aesculus hippocastanum
Tree-of-heaven – Ailanthus altissima
European birch – Betula pendula
One-seed hawthorn – Crataegus monogyna
English holly – Ilex aquifolium
Goldenrain tree – Koelreuteria paniculata
Sweet cherry – Prunus avium
Cherry laurel – Prunus laurocerasus
Portugal laurel – Prunus lusitanica
Black locust – Robinia pseudoacacia
European Mt. Ash – Sorbus aucuparia

Invasive Species

4.94% | $1,993,700



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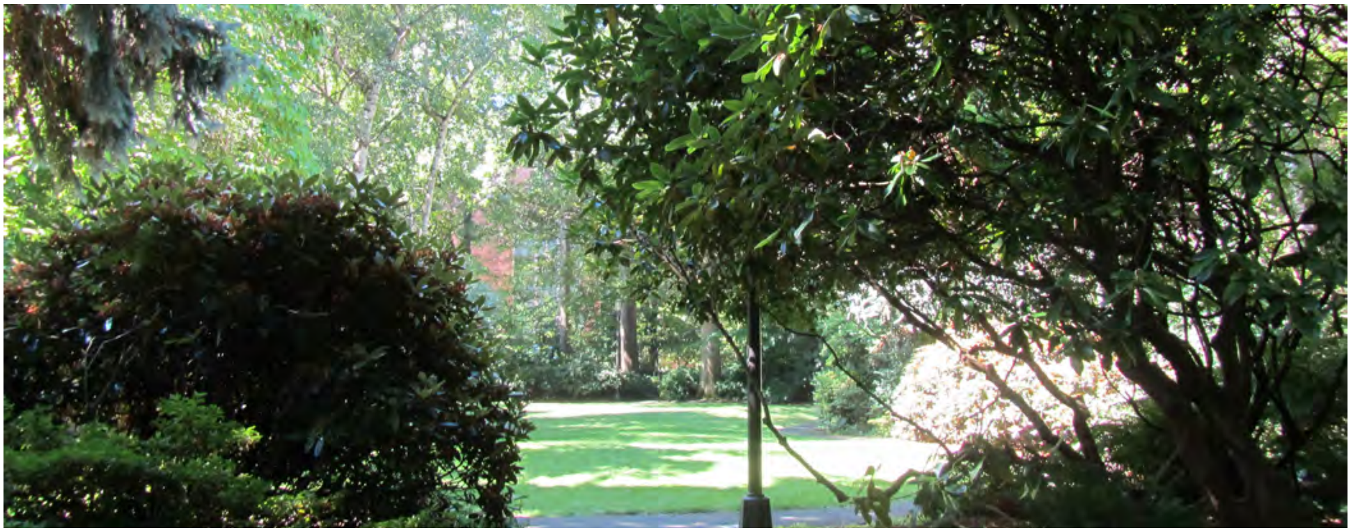


Urban Forest Strategy

From little seeds grow mighty trees

Aeschylus

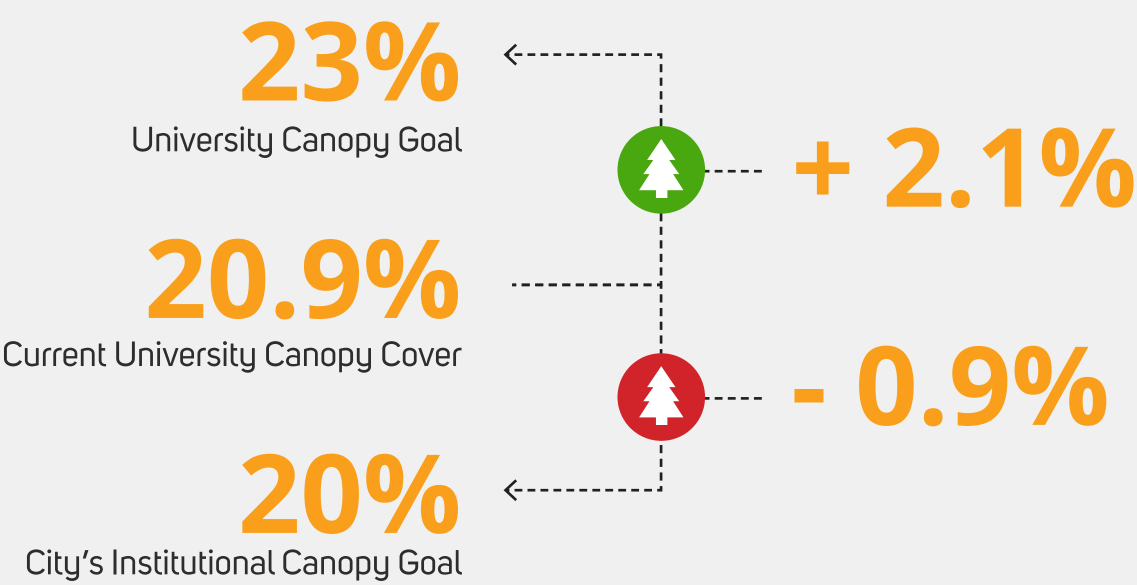
The multi-scalar analysis of the University's landscape results in a range of recommendations and insights that address both short-term and long-term strategies for improving the urban forest and its derivative resources. As the campus evolves, data collection and tracking will be important for evaluating the University's progress towards the identified Urban Forest goals. The strategy also explores the different roles trees can play in shaping the campus environment through their scale, agglomeration, alignment, and context. The use and function of trees on campus should be considered based on the landscape mosaic in which they are located to create a mutually beneficial relationship between site, nature, and architecture. These relationships will be important to consider as the University works towards increasing the canopy cover by 10 percent in each of the neighborhoods by 2037, resulting in a campus wide increase of 2.l percent.

Tree Canopy Goals

UPPER CANOPY | LOWER CANOPY | UNDERSTORY | GROUND COVER

The city of Seattle has defined a tree canopy goal of 20% for all Institutional properties by 2037. This percentage is derived by dividing the total canopy area by the total area of land including buildings and the public right-of-way. Based on the canopy coverage derived from the 2009 Seattle lidar scan, the University has exceeded the city's goal by almost one percent. When only looking at the area of campus that has been surveyed, the campus is one percent away from reaching the city's goal, while the areas of campus that have yet to be surveyed have some of the densest grooves of trees on campus. Having already met the city's institutional canopy goal, the university has defined a goal of 23% canopy coverage by 2037 which equates to an additional 10.3 acres of canopy cover. The strategies and policies to achieve this goal are outline in the following pages through identifying missed opportunities and promoting well established practices. The Campus's urban forest has and will continue to be a part of the University of Washington's legacy and there by needs to be a major topic of discussion when considering the future evolution of campus.

Tree Canopy Coverage



Non-Surveyed Canopy Cover

29.6%
Canopy Cover

Surveyed Canopy Cover

19%
Canopy Cover

Landscape Mosaic

The landscape of the Seattle campus is a diverse mosaic of landscape types. Each type, or piece of the mosaic, has a distinct character and function, ranging from the highly figured "Campus Green" spaces of Denny Yard and Rainier Vista, to the "interstitial or buffer spaces" that are often forgotten, but are found in key locations throughout the campus. By identifying, and describing each element of the mosaic, the urban forest management framework can establish goals that work together with the different spatial functions of campus to create an integrated whole. The reading of the campus as a mosaic celebrates the richness and diversity of landscape types, and resists the temptation to find campus-wide solutions to issues that demand more nuance. Each mosaic element should be addressed on its own terms, taking into account adjacent relationships, but making sure they are treated as having their own integrity. Strategic urban forestry practices can help emphasize the character of each tile within the mosaic while enhancing ecological and social function campus-wide.

WOODLAND GROVE

Character

The woodland grove is the immediately recognizable Pacific Northwest frame for the university, with a mixture of tall evergreens and deciduous trees, and a robust canopy. The continuity of the woodland grove around three sides of central campus is key to the campus character.

INTERSTITIAL / BUFFER SPACE

Character

These spaces are largely defined by adjacent uses, though, in many cases, this does not prevent them from being beautiful or interesting. Interstitial spaces sometimes provide important connections between destinations. Interstitial spaces are typically small in size, fragmented, and scattered across all parts of campus.

THRESHOLD

Character

Thresholds are landscapes whose primary purpose is to provide a transition into or between important moments on campus and as such have a significant role to play in the experience of those more iconic spaces.

URBAN FRONTAGE

Character

Urban frontage is a varied condition on the UW Camups. In some cases, it can be a vibrant and exciting territory between campus architecture and adjacent urban street, or it can be a relatively banal and inhospitable sidewalk between a roadway and a campus building.

LAKE EDGE WETLAND

Character

These landscapes are UW lands that are too wet to be occupiable, but support rich environments and habitat. The sole example of this mosaic type is the generally unstructured shoreline of the Union Bay Natural Area.

GARDEN

Character

The UW is lucky to have a handful of small-scaled, comfortable, inward-looking, lushly planted gardens. For the amount of space they occupy, gardens give back many fold in psychological refreshment.

SERVICE AND PARKING

Character

Service spaces have been designed to accommodate the needs of cars and trucks for service and loading, as well as places to leave cars and continue on foot.

CAMPUS GREEN

Character

Campus greens are clearly figured landscapes, and amongst the most well known parts of the campus. They are often bounded by architecture or by woodland plantings, as in the case of Rainier Vista, and have either open lawns, or lawn beneath a shading canopy, providing space for studying, casual sports, and informal gatherings. The primary spatial relationship of a campus green is between the ground level and the canopy level so these spaces do not usually have beds or shrubs, except at building edges.

MEADOW

Character

The UW's meadows are large swaths of unmown grasses and plants that allow for circulation. The vast expanse of this system makes it a very visible part of the University's natural habitat.

INFORMAL GREEN

Character

Informal Greens are open, unfigured lawn areas, usually found at the campus periphery, and feel less planned and welcoming, even though they share many spatial characteristics with Campus Greens. These spaces are vulnerable to change because they are unresolved with respect to program and use.

RECREATIONAL FIELDS

Character

Either taking advantage of a relatively flat area, or building one from existing topography, recreational fields are large landscape spaces with very high recreational and social value but little to no ecological value.

COURTYARD / TERRACES

Character

Courtyards and Terraces are relatively small, intimate spaces associated with individual buildings. These are frequently, but not always, part of the entry sequence into a building, and are designed to feel slightly separate from campus circulation, with a gardenesque individuality and intricacy.

PASSAGES

Character

Passages are spaces whose primary purpose is to provide a direct route between destinations. At minimum, these spaces should be accessible, but it is preferable if they are also memorable and enjoyable. spaces.

PLAZA

Character

Plazas are large scale figured spaces, usually defined by surrounding buildings. Typically plazas are mostly paved, and allow free circulation across them rather than through defined pathways. Most of the uses that take place in a plaza do not preclude trees, but they are generally open to the sky, with relatively little shade.

CONSTRUCTED WATERFRONT

Character

The Constructed Waterfront includes structured waterfront access, frequently with concrete edges. This type of landscape is usually low in ecological diversity, but high in other types of value such as recreation, passage, research, and moorings.

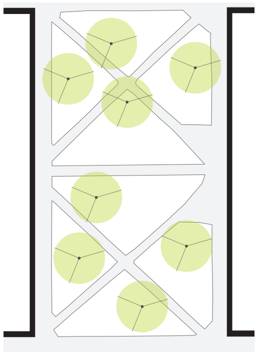
Design Considerations

Trees are used in the landscape to provide a variety of experiences for students, staff, visitors, and faculty as they navigate the campus. Each of the tree design strategies below highlight the experiential quality trees are currently performing from enclosing a space to acting as a landmark in the landscape. These conditions are not limited to a single mosaic, but range a breath of contexts which makes the campus experientially exciting when moving within and between the different neighborhoods. By using these strategies in areas where trees do not exist, it can help connect disparate areas of campus into a seamless and dynamic whole.

Informal

Within many of the lawns of campus, trees are placed into the landscape with no immediate visual order. Denny Lawn and Parrington Lawn are examples of this condition.

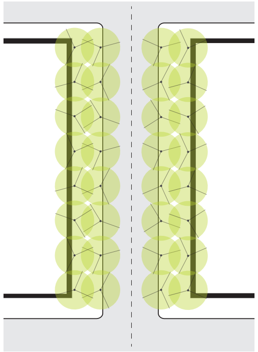
Campus Green, Informal Green



Formal

Allees are used on campus to define ceremonial paths of travel through the campus. They support way finding by helping guide the public into the campus along major vehicle and pedestrian corridors.

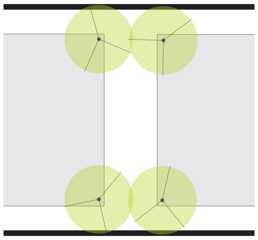
Passage



Frame

Trees can mark the transition between spaces on campus by framing a threshold or vista. Placing two trees at an intersection can help frame important landmarks or mixing zones.

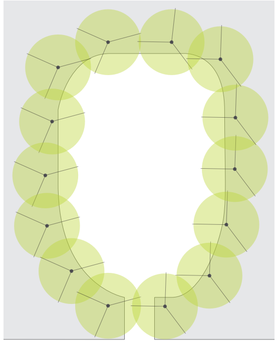
Campus Green, Plaza, Threshold, Garden



Enclosure

Some of the most memorable places on campus like Grieg Garden and Sylvan Grove are enclosed by trees that removes the space from the surrounding context.

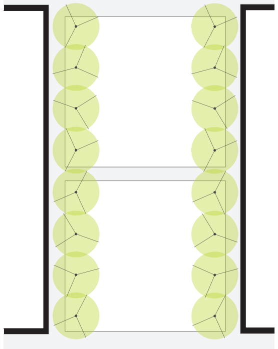
Garden, Courtyard/Terraces



Edge

Trees are commonly used on campus to define the edge of a path, landscape, and open space along with buffering pedestrians from auto infrastructure.

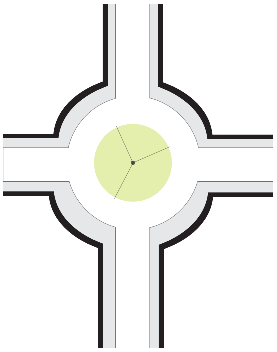
Urban Frontage, Passage, Service and Parking, Campus Green



Landmark

To highlight specific exceptional trees on campus, they have been isolated in the landscape to emphasize their grandeur. These trees require additional management to maintain their vigor.

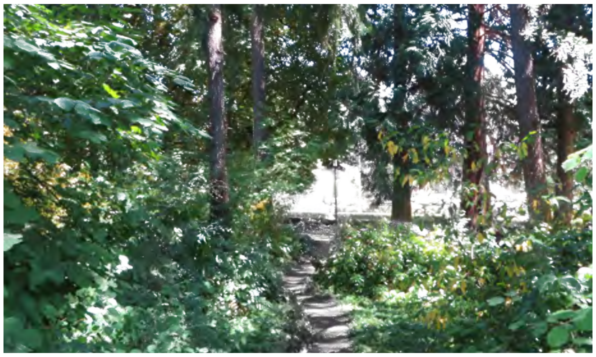
Plaza, Informal Green, Campus Green

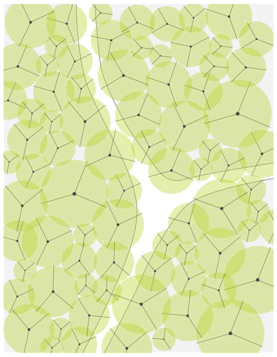


Native

Along the edges of campus and within corridors exists dense groves of trees with a robust under-story that have been preserved and maintained to provide examples of native northwest forests.

Woodland Grove, Meadow, Lake Edge Wetland





NEIGHBORHOOD SNAPSHOT

West Campus

Total Area : 70.6 acres (13.7%)
Landscape Area : 14.9 acres (21.1%)
Tree Canopy : 10.7 acres (15.2%)
# of Trees : 1,276 (15.4%)

Central Campus

Total Area : 217.3 acres (42.3%)
Landscape Area : 91.8 acres (42.2%)
Tree Canopy : 68.3 acres (31.4%)
# of Trees : 4,727 (57.2%)

East Campus

Total Area : 161.2 acres (33.9%)
Landscape Area : 27.6 acres (17.1%)
Tree Canopy : 16.3 acres (10.1%)
# of Trees : 1,468 (17.8%)

South Campus

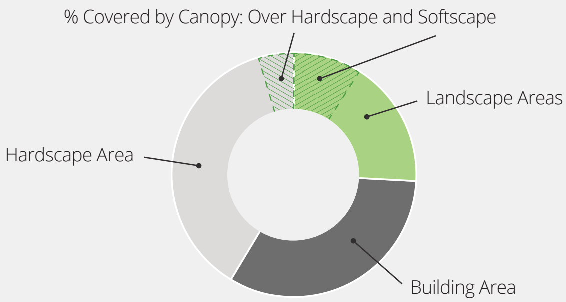
Total Area : 52 acres (10.1%)
Landscape Area : 14 acres (26.9%)
Tree Canopy : 7.4 acres (14.2%)
# of Trees : 798 (9.7%)

Campus Neighborhoods

WEST | SOUTH | CENTRAL | EAST

The University of Washington Seattle campus is made up of four distinct neighborhoods, each comprised of unique functions and aesthetic qualities grounded in their academic relevancy and context. Each zone has clearly defined boundaries that are delineated by steep slopes and major roadways creating strong edges between each neighborhood. This has lead to a campus that has a tremendous range of experiences while also suffering from being disconnected. Central Campus is the quintessential University experience, consisting of the iconic landscapes and architecture. South Campus is predominately covered by the Medical Center and Health Science facilities with valuable waterfront access. West Campus also has access to the waters' edge and is home to student housing and academic facilities. East Campus consists of collegiate athletic uses paired with large parking lots. As unique pieces of the whole, each neighborhood should be integrated into a seamless mesh that is variable yet cohesive.

With each neighborhood having their own unique condition, they require specific goals and strategies based on their nuanced character, function and land use. Analyzing each neighborhood as a whole and then zooming into specific conditions will facilitate the establishment of a strategy that works to identify opportunities and challenges for increasing the canopy cover that emphasizes each neighborhoods primary function. By understanding the relationship between canopy cover, landscaped and hardscaped areas, a canopy goal can be proposed based on the available areas. The neighborhood goals paried with campus wide goals will provide a multi-grain understanding of the campus's urban forest condition along with opportunities for enhancing the experience of the campus by improving its urban forest resource.



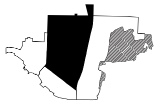
LEGEND

Each campus neighborhood has been stratified into their primary land cover types. The tree canopy cover has been evaluated based on the percentage of hardscape and landscape area that is covered by canopy. This provides a snapshot of what exsits while also showing the potential for increased canopy cover in each neighborhood.

Tree Condition

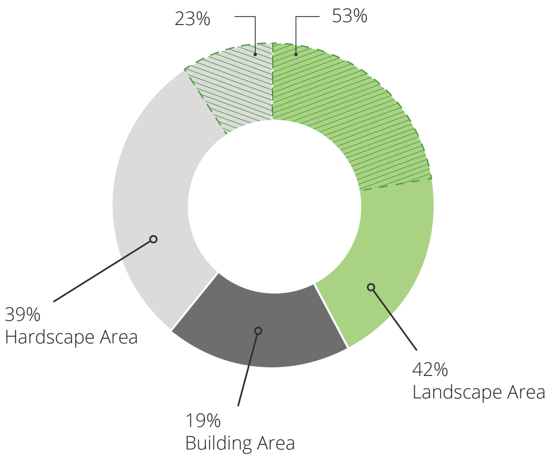
- Excellent : 89 - 100
- Good : 70 - 89
- Fair : 50 - 69
- Poor : 25 - 49
- Very Poor : 0 - 24

Central Campus



4,727 TREES (57.2%) | 217.3 ACRES (42.3%) | 341 SPECIES

Central Campus is the point of origin for most people visiting the University of Washington Seattle Campus. It has clearly defined landscapes, ranging in size and importance from the Rainier Vista to Memorial Way. This neighborhood is the most vibrant with the highest levels of social life, activities, and diversity of students, staff, and faculty. Central Campus is highly developed with limited space for future development that highlights a need to preserve and enhance the urban forest for its environmental, social, and educational values. The balancing of vegetation and building has been well established in this neighborhood with 42% of the ground plane dedicated to landscaped areas. It is recommended to maintain this condition as central campus evolves to meet the demand for new academic facilities.



Central Campus makes up a little over 40% of the University's total land area with more than half of the total number of trees. The canopy consists of 59% deciduous and 41% conifer trees with approximately 37% of the total being native. With a canopy cover of 31.4% and a tree density of 22.27 per acre, Central Campus has the fullest canopy with the highest density of trees on campus.

Tree Canopy
68.3 acres | 31 %

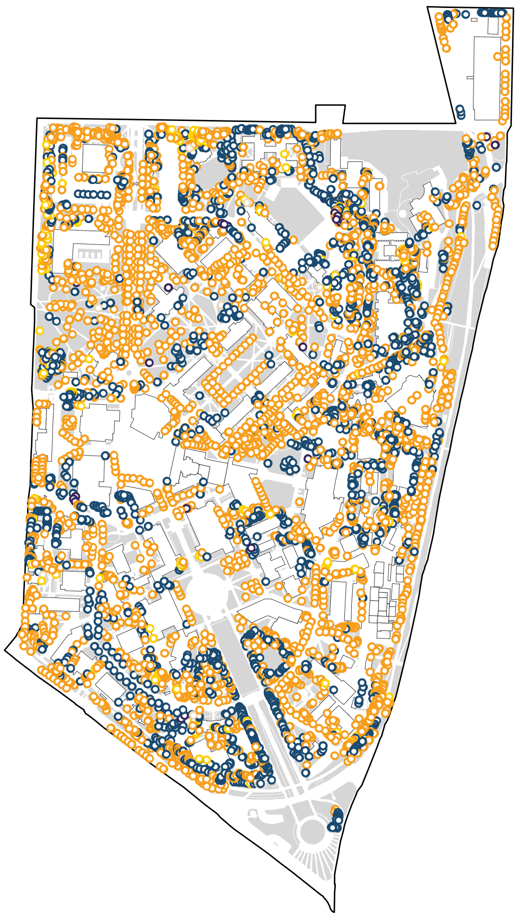
Landscape Area
91.8 acres | 42 %

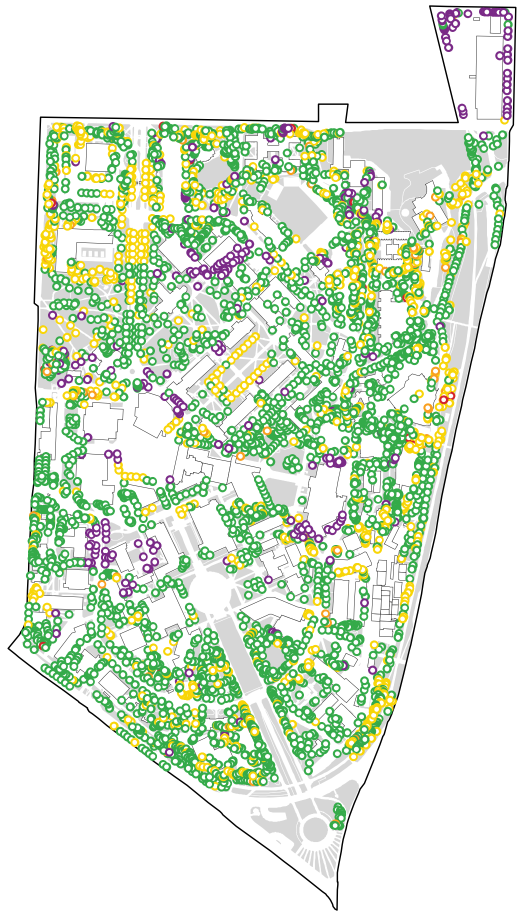
Building Area
40.7 acres | 19 %

Hardscape Area
84.8 acres | 39 %

TREE TYPE AND TREE CONDITION

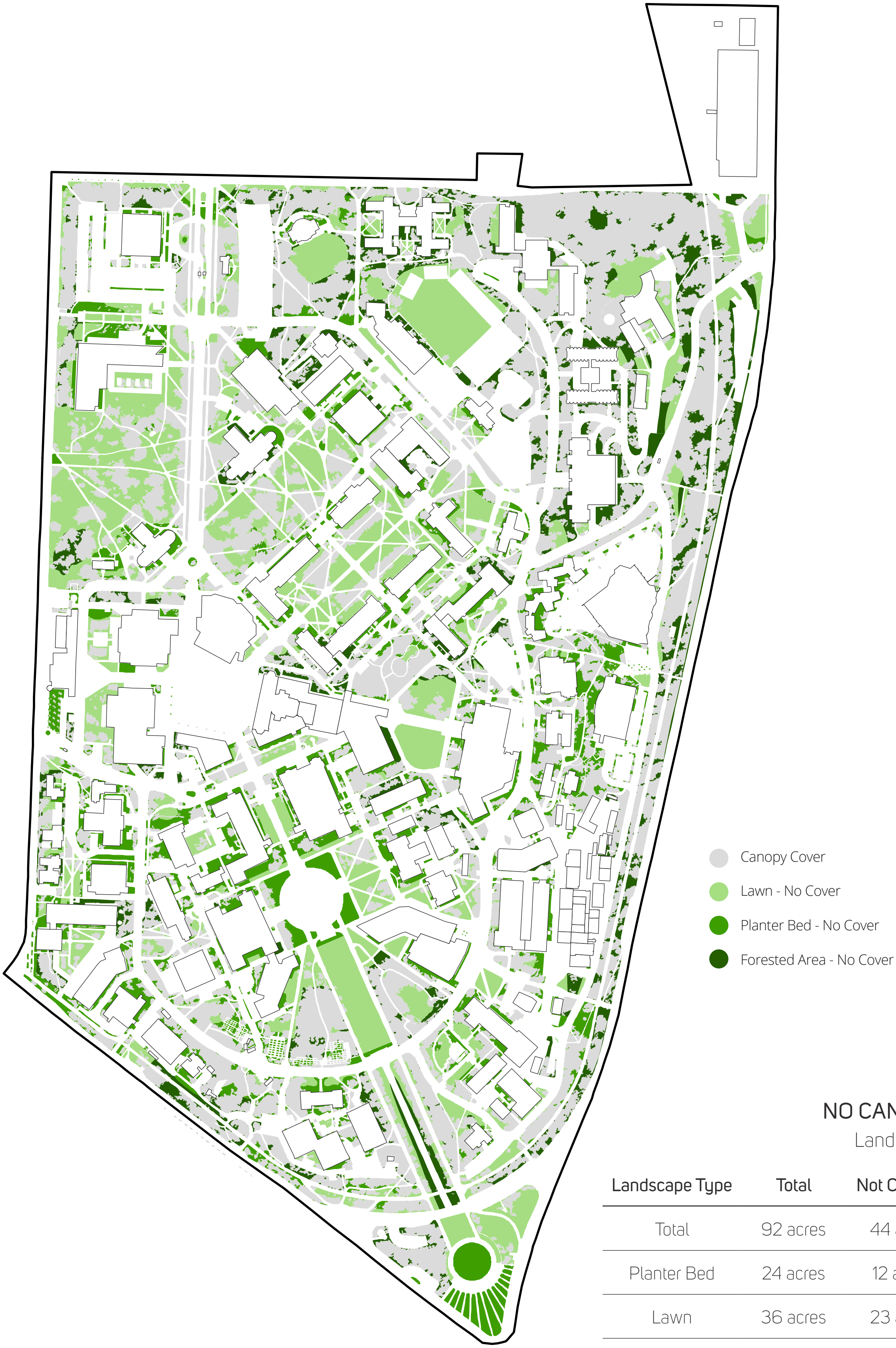
The diversity and density of tree species in Central Campus transforms areas of this neighborhood into nature walks, providing respite from the hectic urban condition, and frames open lawns. The greatest diversity of tree types occurs at the edges of campus where a large volume of future development is planned. Central campus also consists of memorial and iconic landscapes like Memorial Way and the Quad that need to be protected and preserved yet they currently consist of trees that are in fair condition. Fair conditioned trees are scattered across Central Campus while trees in excellent condition are clustered around new development: the HUB, PACCAR, Architecture Hall, and Plant Services. Increasing the diversity of trees while protecting existing trees during construction can help maintain and grow the living lab of trees in Central Campus.





Tree Type	Total	% of Total
Deciduous	2,761	58.4%
Coniferous	1,753	37.1%
Broadleaf Evergreen	171	3.6%
Deciduous Conifer	28	0.6%
Unknown	14	0.3%

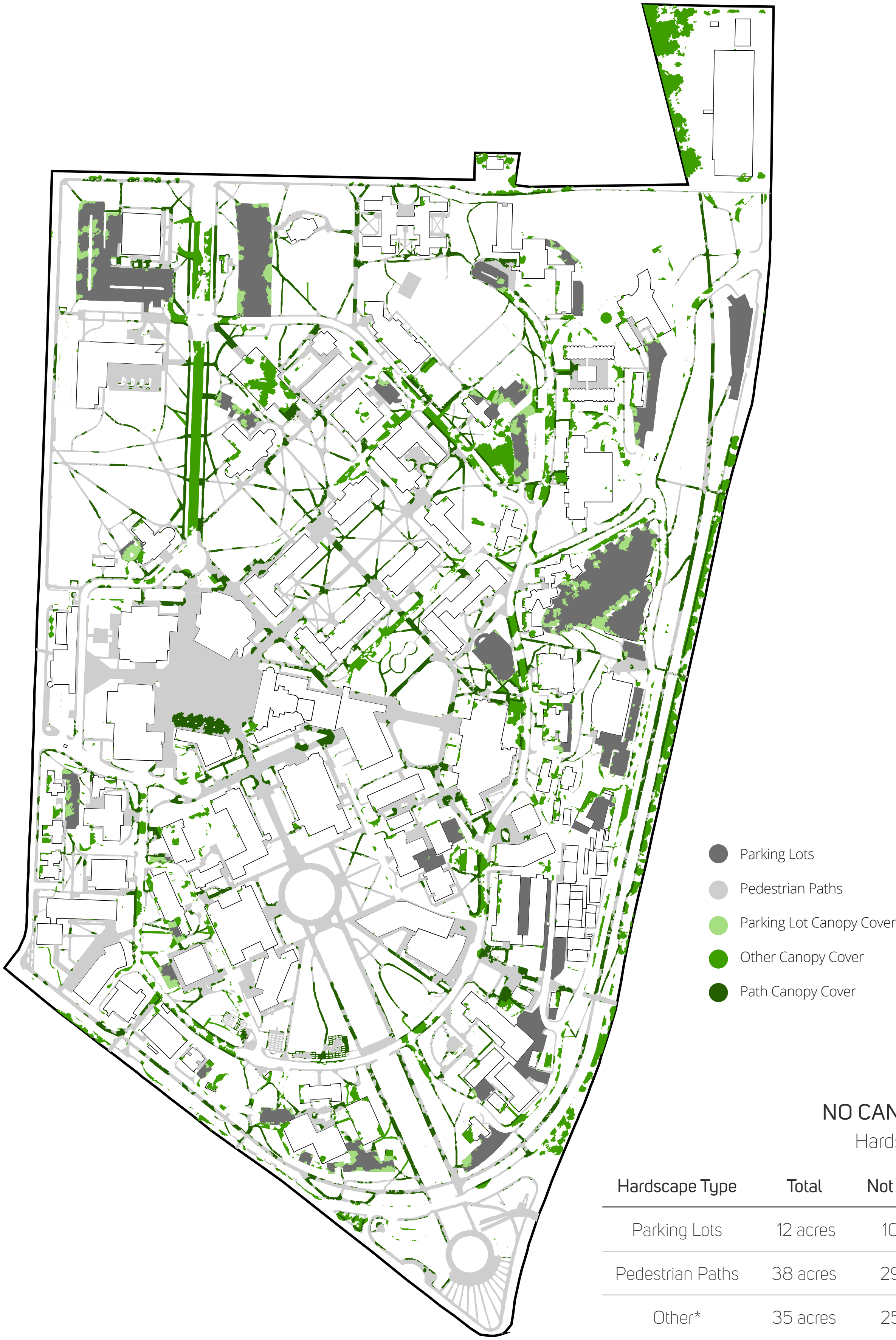
Condition	Total	% of Total
Excellent	296	6.3%
Good	3,311	70%
Fair	1,038	22%
Poor	61	1.3%
Very Poor	21	0.4%



NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	92 acres	44 acres	47%
Planter Bed	24 acres	12 acres	50%
Lawn	36 acres	23 acres	65%
Forested Area	31 acres	8 acres	26%



NO CANOPY COVER

Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	12 acres	10 acres	83%
Pedestrian Paths	38 acres	29 acres	76%
Other*	35 acres	25 acres	71%

** Does not include buildings*

LAWNS

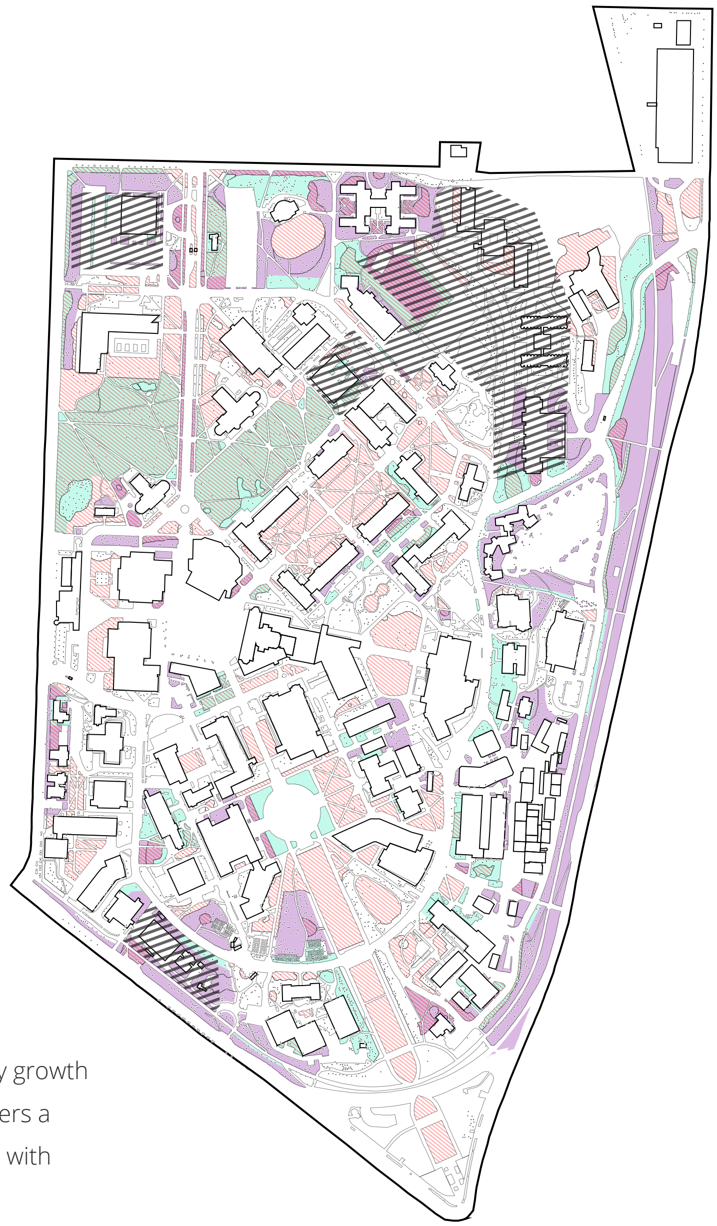
The University has a number of large open lawns with cross-axial paths that speak to the history and evolution of the campus. In some cases, existing trees are aligned along historic paths that no-longer exist giving the trees a random order. Trees play a role as edges, enclosing space, and landmarks. Maintaining the function of the space while providing substantial canopy cover could help organize the lawns into smaller defined spaces with varying micro-climates. Increasing canopy cover needs to be balanced with preserving open lawn for large group events.

DEVELOPMENT

The landscaped areas adjacent to existing surface parking lots and along the edges of Central Campus consist of the densest and maturest grooves on campus. These areas are also the most ideal for development because of their current under-utilization and the lack of developable land. Creative site planning and architectural form making can help protect the mature trees in these areas. Along with protecting existing trees, projects have the opportunity to add to the canopy by adding more trees than the number removed.

IRRIGATION

Irrigation is a critical component for establishing new trees on campus. Not all landscaped areas in Central Campus have automatic irrigation system which limits the University's ability to add new vegetation. Integrating new irrigation systems into the landscape with new development can help expand the areas where additional canopy can be added. Mapping the landscapes that currently lack irrigation on campus will help focus efforts to these areas.



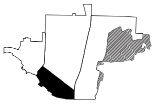
ISSUES AND OPPORTUNITIES

The greatest challenges for adding additional trees in Central Campus are the lack of irrigation and the lack of staff time for manually irrigating. Development is also of concern with there being minimal unoccupied area other than parking lots, lawn, and mature forested areas. Many of the remaining landscapes are iconic to the University and deserve to be maintained as grand open spaces with the potential for adding additional trees. With 44 acres of landscape without canopy cover, there is significant room for canopy growth in Central Campus. The complexity of Central Campus offers a great opportunity for Urban Forestry research associated with development and wildlife habitat to name a few.

ACTION ITEMS

- As development occurs strategically improve adjacent irrigation systems.
- Prioritize landscapes for improvement and characterize aspects that should be preserved.
- Identify areas within central campus where additional trees can be planted.
- Develop a phasing strategy for new tree plantings that leverage unique and established partnerships.
- Work with professors to emphasize the use of the landscape as an education resource.
- Develop outreach materials to showcase restoration projects happening ie. Kincaid Ravine and behind Lewis Hall.
- Create a tree replacement policy for Central Campus that will achieve no net tree canopy loss.
- Explore opportunities associated with adding trees within Red Square.
- Finish surveying trees within Kincaid Ravine and along the Burke Gilman trail.

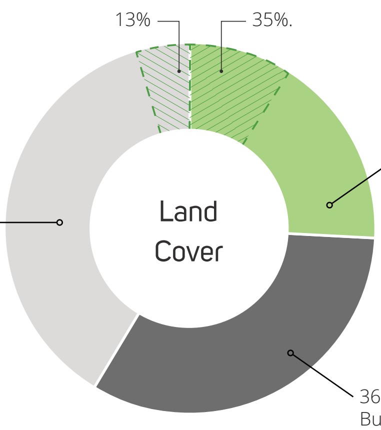
South Campus

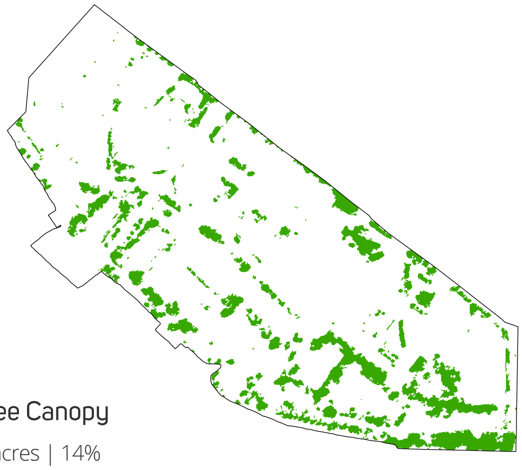


798 TREES (13.5%) | 52 ACRES (10.2%) | 101 SPECIES

The South Campus of UW is dominated by health sciences, with the Medical Center being the major landmark in this neighborhood. The large footprint of the hospital and parking lots, limits the available area where new trees can be planted. With plans to establish new landscapes along the Portage Bay Vista and the waterfront there is an opportunity to significantly increase the health and size of canopy cover in South Campus. Recognizing the limited amount of ground floor space and the visual benefits associated with trees, the University has installed both intensive and extensive green roofs atop existing facilities in this neighorhood. The dense, diverse mosaic of land uses from the water's edge to Central Campus makes establishing a robust, continuous tree canopy challenging.

South Campus currently has the second lowest percentage of canopy cover on campus at 13.4%. This could be due to South Campus having the largest percentage of land area dedicated to buildings on campus . The canopy consists of 1,119 trees (13.52%) covering 67.94 acres (13.4%) of land with 101 unique species. The trees in South Campus are predominately deciduous (80%) with a overall tree density of 16.47 per acre.





Tree Canopy
7 acres | 14%

Landscape Area
14 acres | 27%

Building Area
19 acres | 36%

Hardscape Area
20 acres | 38%

TREE TYPE AND TREE CONDITION

With almost a 1:5 ration between coniferous and deciduous trees, South Campus has the least diversity in terms of tree species. The majority of coniferous trees are located around the entrance to the medical center with others sprinkled along building facades and the waterfront. With over 25% of trees being in Fair Condition and clustered togethered, there is a need to better understand the conditions that exist within these areas to develop strategies for improving tree health. The distribution of poor and very poor trees do not follow any pattern, thus may be the result of improper species selection, specimen choice, or installation/maintenance.

Condition	Total	% of Total
Excellent	85	11%
Good	489	61%
Fair	215	27%
Poor	7	1%
Very Poor	2	0.5%

Tree Type	Total	% of Total
Deciduous	633	79%
Coniferous	132	17%
Broadleaf Evergreen	23	3%
Deciduous Conifer	5	0.5%
Unknown	5	0.5%

NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	14 acres	9 acres	65%
Planter Bed	7 acres	4 acres	59%
Lawn	6 acres	4.5 acres	79%
Forested Area	1 acres	.4 acres	37%

NO CANOPY COVER

Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	2.5 acres	2.4 acres	96%
Pedestrian Paths	7.4 acres	6.3 acres	85%
Other*	10.1 acres	8.9 acres	88%

** Does not include buildings*

UW HOSPITAL / HEALTH SCIENCES

Health Sciences and the University Hospital occupies the majority of land in south campus, limiting the amount of space for surface level landscapes. The hospital has utilized some of its roof surface for landscaping which could be expanded to more areas. Providing a view of nature from patients' rooms and offering vegetated spaces for reflection and respite could aid with patient recover while enhancing the canopy cover in South Campus.

WATERFRONT

The waterfront in south campus has two primary conditions; remnants of the historic UW golf course and an industrial edge, all of which provides an abrupt transition from the land to the water. The industrial edge has little to no vegetation and does not offer opportunities for the public to omce in contact with the water. The vegetated areas consist of large open lawns with allees of trees that once framed the fairways of the University Golf Course until 1947 when it was replaced by the UW School of Medicine.

COURTYARDS & VISTA

In order to provide public exterior open space in South Campus, on structure courtyards have been designed into the architecture to provide needed outdoor vegetated spaces. The function and use of courtyards varies between primary entrances, places for refuge, and visual beauty. Each condition requires different design considerations, but can all benefit from having additional trees planted of varying species to increase the volume, color, and shade within an environment dominated by concrete, steel, asphalt, and brick.

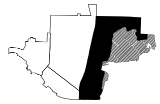
ISSUES & OPPORTUNITIES

South Campus makes up 10% of the campus's total land area, while having 13.5% of the total trees. With a large percentage of trees in Fair condition, there needs to be a strategy for improving them that also begins to create institutional knowledge for tree conditions in this neighborhood and across campus. There is some private ownership along the waterfront in South Campus which limits the university's ability to fully improve its ecological and social condition. With approximately 65% of the total landscape and 96% of parking lots not having any tree canopy, it provides over 11 acres of land that could be planted with trees in the future.

ACTION ITEMS

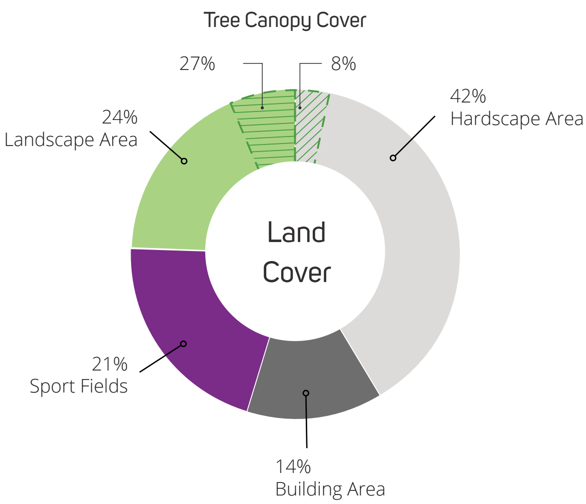
- Develop green infrastructure standards that emphasizes green roofs across campus with an emphasis on the medical center.
- Create a shoreline restoration plan that protects the shoreline and enhances aquatic habitat for endangered salmon species.
- Celebrate the historic conditions that exist along the waterfront with enhanced open space and strategic water access.
- Strategically use trees to help connect South Campus to other neighborhoods on campus.
- Establish a focused management plan for improving the 26.9% of trees currently in fair condition.
- Emphasize landscaped courtyard development within large buildings to create healing and therapeutic spaces and views.
- Maximize trees within Portage Bay Vista while preserving view.

East Campus



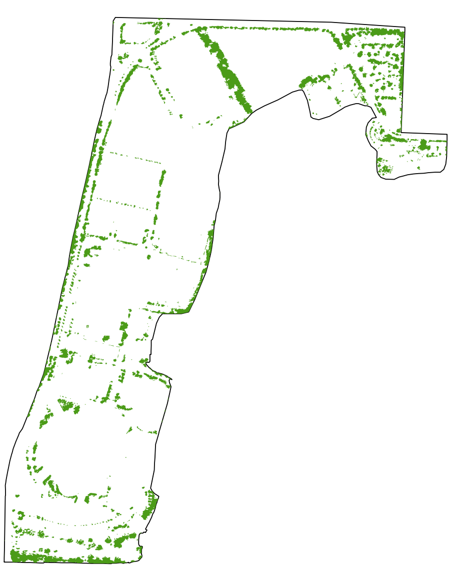
1,468 TREES (17.8%) | 174.3 ACRES (33.9%) | 148 SPECIES

East Campus emphasis is collegiate athletics; sports fields, gyms and stadiums. Accompanying these land uses is a sea of surface parking lots that are designed for the capacity of major sporting and ceremonial events. But as development and transportation systems evolve with the opening of a new light rail station along with improvements to the Burke Gilman Trail, a reduction in parking spaces may be needed in the future. East campus also consists of family-student housing and additional campus facilities along its Eastern edge, making a pedestrian friendly environment between Central Campus and these areas of value to those communities. Between the stadiums and family-student housing is the Union Bay Natural Area which is not included in this analysis because it has yet to be surveyed and is not managed by the University of Washington's Grounds staff, but does provide significant ecological, educational, and cultural value to the University.



East Campus has the lowest canopy cover percentage out of the four neighborhoods due of hardscape, buildings, and sports fields dominating the environment. With only 8% of the hardscape covered by canopy, additional plantings would be welcomed in these areas. The parking area behind HEC Edmundson Pavilion provides a good example to how trees can be integrated into parking lots.

Tree Canopy
17.2 acres | 10%

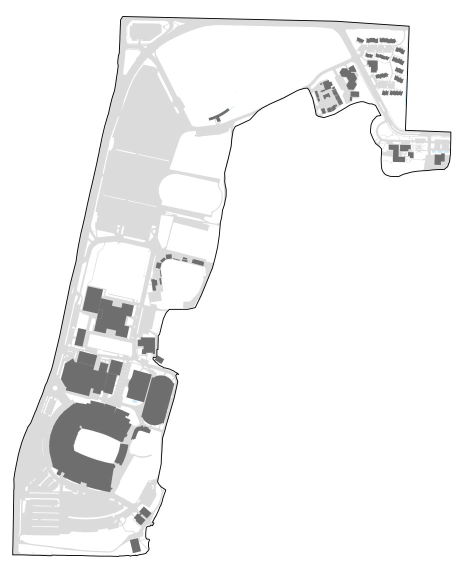


Landscape Area
42.3 acres | 24%

Sport Fields
36 acres | 21%

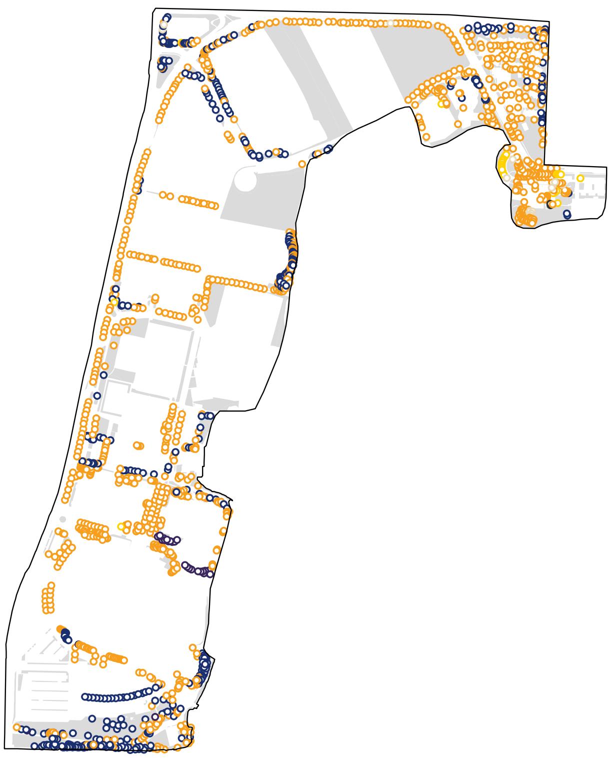
Building Area
23.2 acres | 13%

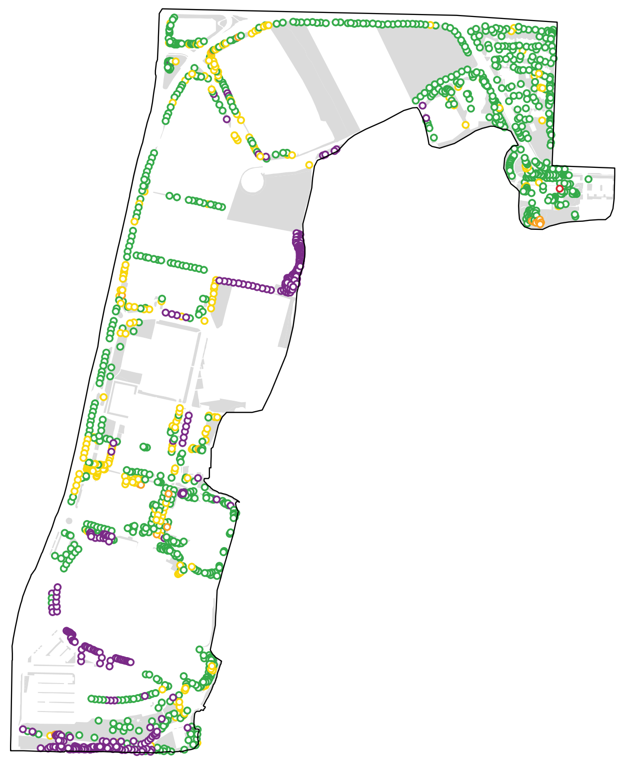
Hardscape Area
72.5 acres | 42%



TREE TYPE & TREE CONDITION

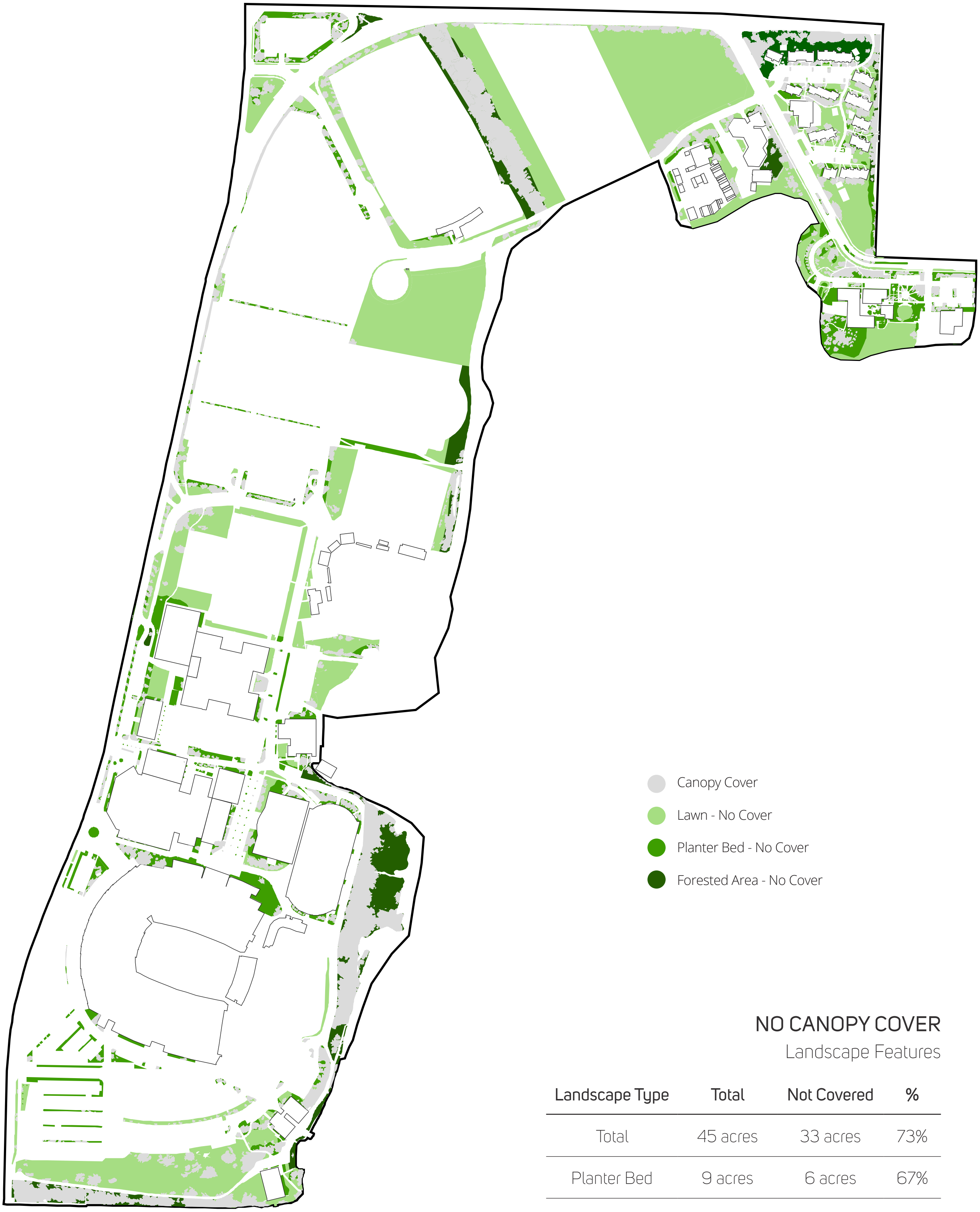
East Campus's canopy consist of 69% deciduous trees with 35% of the total trees being native at a density of 8.16 trees per acre. Within the existing landscaped areas there are large open areas where trees could be easily added. One challenge to increasing canopy cover in this zone is the conflict between trees, sport fields, parking stalls, and vehicular circulation which are paramount to the function of East Campus. The condition and density of trees vary between the urban edge, new development, and student housing. The urban edge has a significant number of trees in fair condition while a large percentage of trees in good condition are located around the student housing, student farm, and Center for Urban Horticulture. Like other neighborhoods, the majority of excellent trees are associated with recent development projects. With this neighborhood also having access to the water, its edges could be greatly improved by softening them with additional plantings.





Tree Type	Total	% of Total
Deciduous	992	67.6%
Coniferous	398	27.1%
Broadleaf Evergreen	34	2.3%
Deciduous Conifer	26	1.8%
Unknown	14	1.0%
Palm	4	0.3%

Condition	Total	% of Total
Excellent	295	20.3%
Good	910	62.6%
Fair	231	15.9%
Poor	17	1.2%
Very Poor	1	0.1%



NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	45 acres	33 acres	73%
Planter Bed	9 acres	6 acres	67%
Lawn	28 acres	24 acres	86%
Forested Area	8 acres	3 acres	38%

NO CANOPY COVER
Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	30.4 acres	29.8 acres	98%
Pedestrian Paths	12.4 acres	10.8 acres	87%
Other*	29.7 acres	25.2 acres	85%

** Does not include buildings*

HARDSCAPE

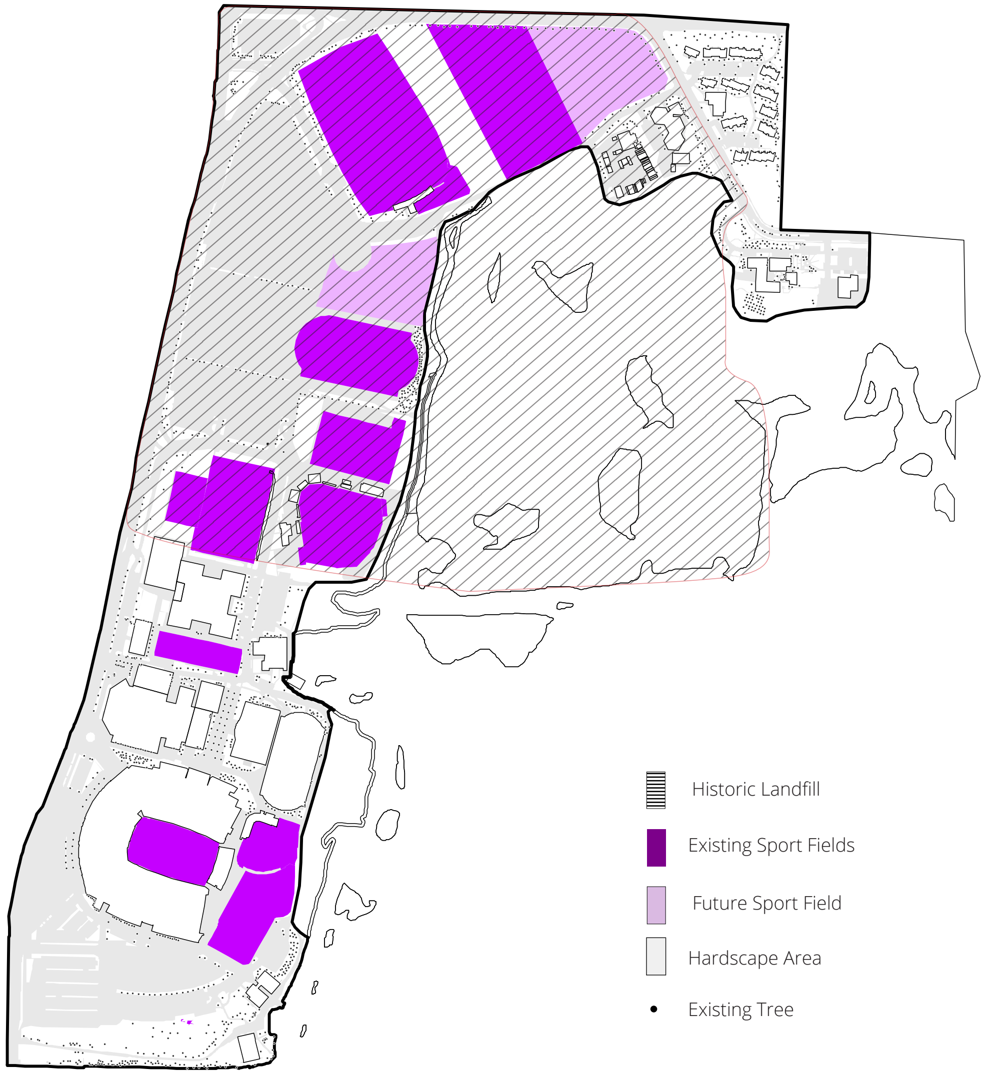
The amount of terrain covered in hardscape creates an exposed and harsh environment throughout the year making it an unenjoyable place to be and move through. With the addition of the new light Stadium Station, there will be significantly more people walking through this area on their way to U. Village and campus, so providing circulation that is buffered from cars will need to be improved. Placing trees within this landscape provides a strong contrast to the asphalt that could aid with wayfinding.

SPORT FIELDS

Collegiate athletics are a critical part of the University of Washington's identity. They require a broad open space for each sporting activity, seating, and operational needs. The requirements of these facilities limits the siting of trees within stadiums, courts, or fields, but could be utilized around each facility to help block the wind and sun providing a more pleasant environment for viewers and participants.

HISTORIC LANDFILL

Historically this area was used as a municipal landfill that was closed and capped in 1971. Drainage and settlement issues can be seen while walking through East Campus, making the addition of trees complex. Today, a Montlake Landfill Project Guide has been developed to define what is possible in the landfill area by defining allowable maintenance and construction activities. Despite this challenge, E-1 parking lot, the driving range, and undeveloped sports offer open space for new tree plantings.



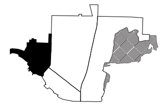
ISSUES & OPPORTUNITIES

Integrating trees into the parking lots, stadiums, and sport fields provides the best opportunity for increasing canopy cover in East Campus considering that 98% of the hardscape has no canopy cover. Strategic tree plantings could help connect East Campus to adjacent neighborhoods by highlighting points of access and street crossings. Montlake Boulevard is a strong barrier to campus that could also benefit from additional tree plantings along with the widening of the sidewalk. The presence of the historic landfill makes it challenging and expensive for adding new features at any scale. With the predominate use being athletics and sport fields, there needs to be strategies developed for how to maximize canopy cover associated with these land uses.

ACTION ITEMS

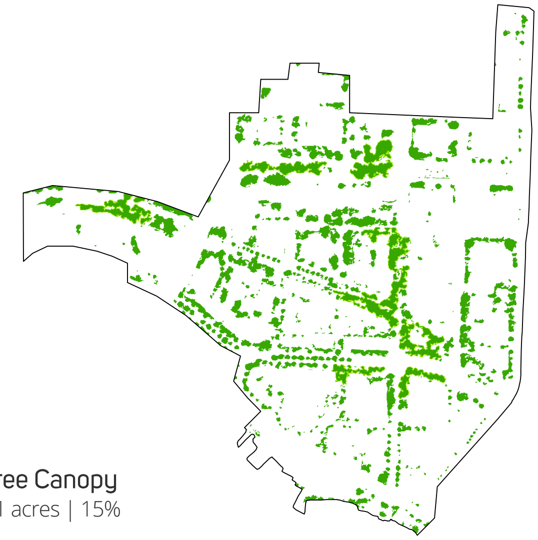
- Explore creative strategies for increasing tree canopy cover in and around stadiums and parking lots.
- Work with the Center for Urban Horticulture on establishing a research focus in Urban Forestry practices.
- Use trees as a wayfinding tool to promote a stronger connection between UBNA, U. Village, lightrail station, CUH, and the stadiums.
- Utilize the historic dump condition as an opportunity for research associated with adding and maintaining landscape in this unique environment,
- Extend the UBNA's natural condition into adjacent areas to expand and leverage environmental services.
- Complete a tree survey of the Union Bay Natural Area (UBNA).

West Campus

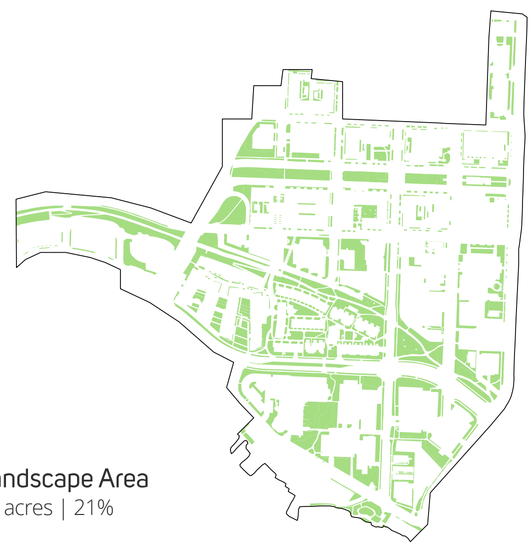


1276 TREES (%) | 70.6 ACRES (13.9%) | 155 SPECIES

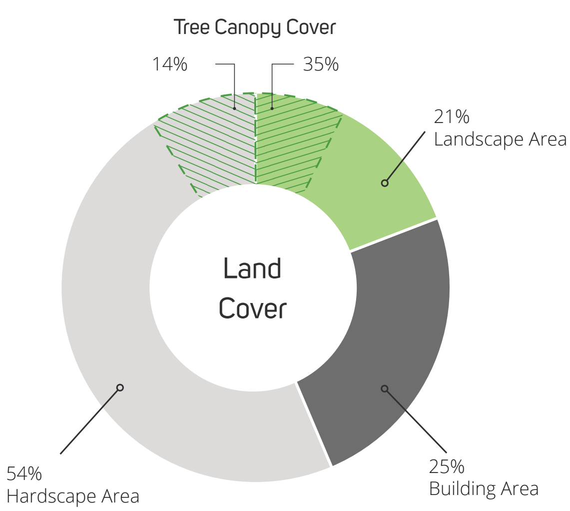
West Campus is characterized by its integration into the urban fabric of the University District with the primary land uses being shared between student housing and educational facilities. The scale of buildings range from one to 6 stories, each possessing few landscape moments. Instead, West Campus is spotted with small semi-public courtyards and terraces that are part of the architecture. Trees are being used in West Campus to line streets, buffer buildings from the sidewalk, and as path edges. Landscapes moments of note are the plaza in-front of Elm Hall, Mercer Court Garden Terraces, Burke Gilman Trail, Fishery Sciences wetland garden, and Sakuma Park. Each space showcases the diversity of environments that are accessible to students, staff and visitors. The streetscape and design of buildings plays the biggest role in establishing a complex forest canopy in this zone, but is challenging due to existing conditions that are not ideal for new plantings. While the Campus Parkway median offers a great opportunity for additional tree plantings.

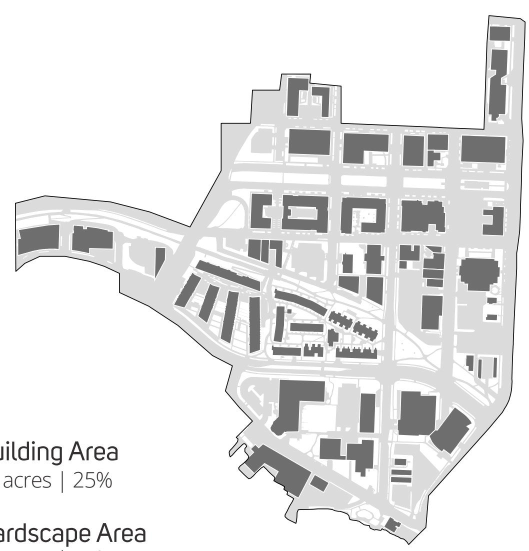


Tree Canopy
11 acres | 15%



Landscape Area
15 acres | 21%





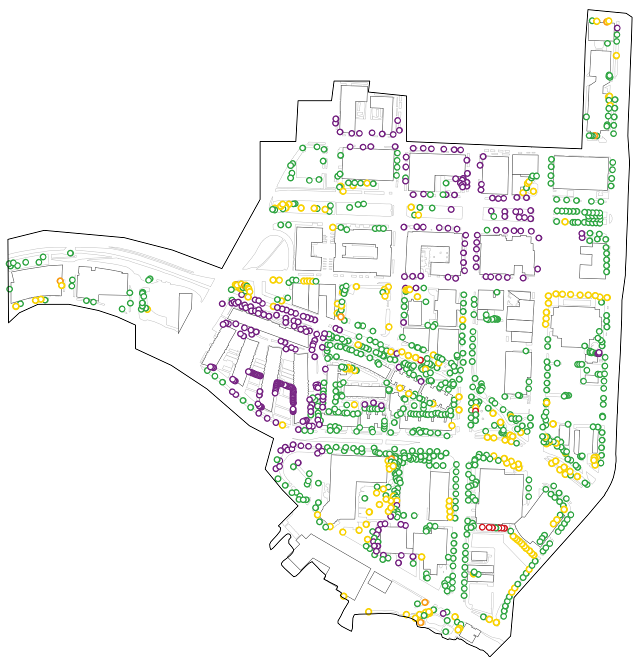
Building Area
18 acres | 25%

Hardscape Area
38 acres | 54%

TREE TYPE & TREE CONDITION

The diversity of tree species in West Campus is high with 155 unique varieties that are mostly in fair to excellent condition. With the large amount of recent development in West Campus, many of the trees within this neighborhood are young and have been given an initial condition rating of excellent. The few trees that have a poor or very poor condition rating are predominately broadleaf evergreens (Acacia melanoxylon) located on the south side of the west campus parking garage. Coniferous trees are scattered across west campus in low densities with the majority being along the Burke Gilman Trail. Conifers are most commonly sited directly in front of building facades or within a grove of similar aged trees.

Tree Type	Total	% of Total
Deciduous	1,031	80.8%
Coniferous	173	13.6%
Broadleaf Evergreen	54	4.2%
Deciduous Conifer	9	0.7%
Unknown	7	0.6%
Palm	2	0.2%



Condition	Total	% of Total
Excellent	286	22.4%
Good	774	60.7%
Fair	200	15.6%
Poor	7	0.6%
Very Poor	9	0.7%

NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	15 acres	10 acres	65%
Planter Bed	8 acres	5 acres	63%
Lawn	4 acres	3 acres	75%
Forested Area	3 acres	1.5 acres	50%

NO CANOPY COVER

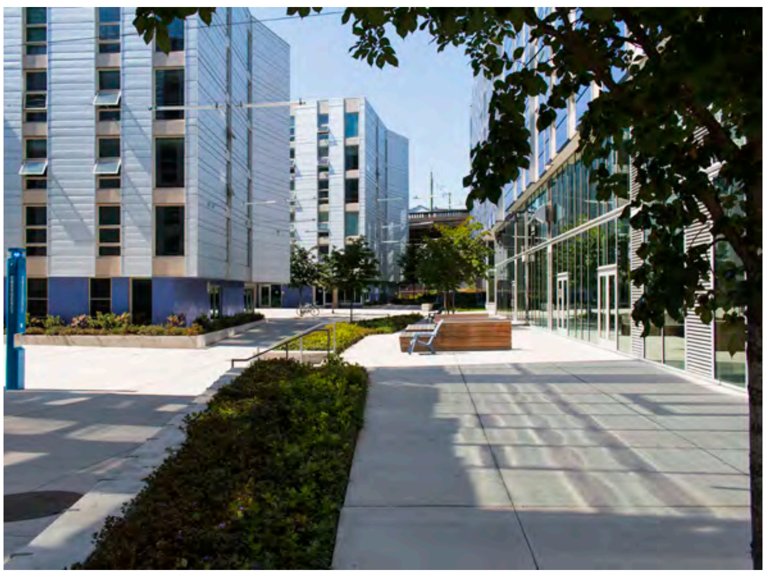
Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	5.4 acres	5.2 acres	96%
Pedestrian Paths	9.3 acres	7.5 acres	76%
Other*	23.3 acres	19.9 acres	85%

** Does not include buildings*

STREET CANOPY

West Campus has a diverse urban edge, with varing sidewalk and road widths. A full range of canopy cover volumes can be experienced walking in West Campus from complete cover to fully exposed. The challenge of not having enough space along the sidewalk for street trees is one issue that is componded by the careful negotiation that is required with below and above-grade utility infrastructure.



WEST CAMPUS HOUSING / FUTURE DEVELOPMENT

A large percentage of West Campus is dedicated to student housing. With each new dorm, new semi-public courtyard spaces are integrated into the architecture. Within these courtyard spaces, trees should be leveraged to provide pleasing environments that blur the boundary between the exterior and interior. The proper placement and density of trees within these environments should be a major topic of discussion during the design process.

WATERFRONT

The West Campus waterfront is evolving to provide greater public access and improve the environmental quality of the shoreline. As new development occurs along and near the waterfront, protecting the shoreline with trees while providing access to the waters edge needs to be balanced. The strategic use of trees throughout West Campus could help guide the public to the water and aid with integrating the waterfront into adjacent Campus neighborhoods.

ISSUES & OPPORTUNITIES

The density of buildings within the existing urban grid makes finding places to add trees challenging. As new development occurs building footprints should be designed to preserve existing trees while providing additional space for new landscapes. Identifying gaps within the existing urban forest along street edges can be areas of focus for increasing the diversity of trees in West Campus. With a new park under development along the waterfront, it offers the chance to enhance the waters edge for salmon and other wildlife while growing the forest canopy cover into West Campus from the waters edge. With 10 acres of landscape and 5.2 acres of parking without canopy cover, there is an significant opportunity for increasing tree canopy cover.

ACTION ITEMS

- Conduct a more detailed analysis of existing sidewalk conditions to identify specific issues and opportunities for tree plantings along the street edge.
- Prioritize Campus Parkway's median as a future design project that adds both public space and canopy cover to the space.
- Work with the city on enhancing the environmental performance of the streetscape.
- Use trees along proposed green streets to connect West, Central and South Campus to the waterfront and to one another.
- Build upon the implementation of a Waterfront Park and the West Campus Development Proposals to enhance the shoreline into a high functioning ecological zone.

Neighborhood Canopy Goals

Proper and strategic tree selection is vital when working towards a specific canopy goal. Each tree has its own dimensions that reflect the overall shape of the tree from pyramidal to columnar. Choosing trees that have a wide mature canopy width can greatly reduce the number of trees needed to achieve canopy goals for each campus neighborhood and the campus overall. Canopy Goals for each of the campus neighborhoods were derived by comparing the results of the analysis below with the available land in each campus neighborhood for new plantings. Integrating this type of quantitative thinking during the planting design phase of a project could help with projecting potential canopy volumes over time.

Canopy Diameter (ft)	Area per tree (sq ft)	# of trees per acre
5	*20*	*2,218*
10	*79*	*555*
15	*177*	*246*
20	*314*	*139*
25	*491*	*89*
30	*707*	*62*
35	*962*	*45*
40	*1,257*	*35*
45	*1,590*	*27*
50	*1,963*	*22*
55	*2,376*	*18*
60	*2,827*	*15*
65	*3,318*	*13*
70	*3,848*	*11*
75	*4,418*	*10*
80	*5,027*	*9*
90	*6,362*	*7*
100	*7,854*	*6*

Metasequoia glyptostrobodies **20'**

Circidiphyllum japonicum **40'**

Juglans nigra **70'**

10 ACRE INCREASE IN CANOPY COVER BY **2037**

NEIGHBORHOOD	CANOPY GOALS		ADDITIONAL TREES PER YEAR	
CENTRAL CAMPUS	Existing Canopy Cover :	31% (68.3 acres)	30' DBH :	20 trees per year
	Addition Canopy Cover :	6.8 acres	45' DBH :	9 trees per year
	Canopy Cover Goal :	**34% (75.1 acres)**	60' DBH :	5 trees per year
SOUTH CAMPUS	Existing Canopy Cover :	14% (7 acres)	30' DBH :	2 trees per year
	Addition Canopy Cover :	0.7 acres	45' DBH :	0.9 trees per year
	Canopy Cover Goal :	**15.4% (7.7 acres)**	60' DBH :	0.5 trees per year
WEST CAMPUS	Existing Canopy Cover :	15% (11 acres)	30' DBH :	3 trees per year
	Addition Canopy Cover :	1.1 acres	45' DBH :	1.4 trees per year
	Canopy Cover Goal :	**16.5% (12.1 acres)**	60' DBH :	0.8 trees per year
EAST CAMPUS	Existing Canopy Cover :	10% (17.2 acres)	30' DBH :	5 trees per year
	Addition Canopy Cover :	1.7 acres	45' DBH :	2.2 trees per year
	Canopy Cover Goal :	**11% (18.9 acres)**	60' DBH :	1.2 trees per year
TOTAL	Existing Canopy Cover :	20.9% (103.5 acres)	30' DBH :	30 trees per year
	Addition Canopy Cover :	10.3 acres	45' DBH :	13 trees per year
	Canopy Cover Goal :	**23% (113.8 acres)**	60' DBH :	7.5 trees per year

The University of Washington's Seattle Campus is a dynamic landscape constantly changing as structures and landscapes are added, removed, and upgraded. Weather also plays an important role; wind, lightening, and extreme hot and cold are also causing the landscape to evolve in both a positive and negative direction. These conditions make achieving a static goal difficult, so in order to maintain and go beyond the city's Institution Canopy Goal of 20% the university has established a goal of 2.1% (10 acre) increase in canopy cover by 2037. In order to achieve this goal, the type and sizes of trees being removed and added need to be considered. Achieving increases in each neighborhood can be accomplished by having a net increase of 8 - 30 trees per year depending on the mature canopy volume of the trees planted. In addition to adding new trees where none currently exists, there also needs to be a tree replacement policy established that requires new projects to match or add to the tree canopy that previously existed on the site. In order to monitor the progress of this goal, the University will need to maintain an up-to-date GIS tree database with an updated campus lidar scan to track and better align management and operations processes with changes to the University's Urban Forest.

Campus Wide Strategy

The urban forest is constantly changing and evolving making accurate monitoring critical for understanding how the urban forest is changing. In addition to monitoring, strategic outreach and partnerships can help create a greater awareness of the resource that the University has along with growing the educational knowledge within the profession.

Standardize Lidar Scan Schedule

If the university wants to accurately tract the evolution of its tree canopy, having periodic lidar scans is of utmost importance. As development continues to occur on campus it will be of value to monitor how it is impacting the Urban Forest and to see how the canopy is changing over time.

TASKS

1. Contact in-house staff and professors who have Lidar Scanning equipment and are experienced with conducting large surveys.
2. Identify the cost for having it completed by a consultant.
3. Develop a time-line for campus wide scanning frequency.
4. Explore different opportunities for scanning at different scales.
5. Establish a methodology for conducting Lidar Scans of Campus.

BENEFITS

1. Track tree canopy goals
2. Provides an updated 3d point cloud of campus that can be translated into accurate 3d models
3. Supports cross disciplinary and interdepartmental partnerships.
4. Can be used for campus development needs.

Maintain an up-to-date GIS Tree Database

The University began a process to survey all of the trees on campus resulting in approximately 85% of the trees being documented in a database. Since then substantial construction has taken place on campus changing the forest's structure on campus. Completing the survey and having a methodology to keep the database up-to-date will allow the University to monitor how the urban forest is changing on a tree-by-tree basis.

TASKS

1. Identify the cost for completing tree surveying in non-surveyed areas.
2. Work with the campus arborist and campus landscape architect on identifying the needs of the existing tree database.
3. Define a methodology for updating the tree database when projects on campus occur.
4. Identify different funding sources for completing these tasks.
5. Complete a comprehensive update to the tree database.
6. Explore the value of aligning UW's tree database with iTrees standard.

BENEFITS

1. Used to identify existing trees located within the limit of work of construction sites.
2. Allows the university to track the changing diversity, age, and health of trees on campus.
3. Can be provided to the city to be used with their online tree maps.
4. With iTree formatted data, environmental value can be quantified.

Increase the diversity of trees on campus

In establishing a resilient urban forest, a diversity of trees in age, type, and size should be intermixed throughout campus. This will help protect the University's urban forest from large infestations and massive tree death. Having greater diversity on campus will emphasize the forest as a learning resource for students, staff, guest, and professors.

TASKS

1. Develop standards for planting new trees on campus.
2. Work with grounds staff to identify locations on campus where new trees can be planted.
3. Create a planting palette for campus.
4. Create a Replacement Plan for aging and unhealthy trees on campus.
5. Strengthen the discussion related to tree plantings during the design process of projects.
6. Identify funding sources to plant additional trees on campus.
7. Build upon the successes of student lead restoration projects to increase their occurance on campus.
8. Develop a tree replacement policy for trees removed due to construction.

BENEFITS

1. Helps build a resilient urban landscape
2. Builds upon the University's goal of turning the landscape into a "Living Laboratory"
3. Strengthens the cultural value that the forest adds to the University.
4. Enhances wildlife habitat on campus
5. Different tree types can be leveraged for their environmental services resulting in cost savings.

Improve the health of trees on campus

The university's forest could benefit from management that improves the health of each tree. Having a strategy for improving the health of existing trees can help minimize costs associated with tree removal, damage caused by unmaintained trees, and maintenance.

TASKS

1. Identify all the trees on campus that are currently in fair, poor and very poor health.
2. Conduct an evaluation of the different site conditions and management associated with trees in poor health.
3. Create a series of BMP's that define steps towards improving tree condition.
4. Define lightning protection standards for high value trees on campus.
5. Develop a means for conducting additional tree maintenance on unhealthy trees.
6. Monitor new tree plantings on campus to identify issues with specific sites and conditions.
7. Develop a weed removal plan to enhance the environmental quality where trees can thrive.
8. Prescribe a strategy for protecting trees from deadly bugs and disease.
9. Explore project opportunities with the Green Seattle Partnership, Campus Sustainability Fund, and EarthCorps.

BENEFITS

1. Provides the public with Northwest specimen trees.
2. Helps protect the cultural value of trees on campus.
3. Helps to minimize maintenance and operation costs.

Align University tree policies with the city's

Working with city of Seattle to align goals and policies could benefit both parties through information sharing and support. The city of Seattle has a history of promoting urban forestry so by working closely with them the university can benefit from their insight into challenges and opportunities associated with Urban Forestry.

TASKS

1. Establish a partnership with the city to share information and tools.
2. Coordinate with the city for the university to be part of existing urban forestry meetings or establish a new group focused on this effort.
3. Work with the city on testing innovative permitting processes associated with "Exceptional Tree" policy.
4. Develop opportunities for joint educational events in the classroom and/or to the public.
5. Collaborate to define Urban Forestry research topics of interest that are of value to both parties.

BENEFITS

1. Builds upon the strong relationship between the city and the University.
2. Has the potential to expedite permitting processes related to "exceptional trees."
3. Grows institutional knowledge associated with urban forestry.
4. Standardizes University's urban forestry language to match the city's

Establish an academic focus in Urban Forestry

In order to grow the knowledge base of urban forestry there needs to be an academic focus in the field to support research. The University has an academic program in Forestry and a Center for Urban Horticulture yet does not have a focus in urban forestry.

TASKS

1. Identify professors that have an interest in the topic Urban Forestry.
2. Talk with local urban forestry managers about educational needs and opportunities.
3. Meet with academic departments that focus on the natural environment about administering the program.
4. Work with the Center of Urban Horticulture on establishing an urban forestry focus.
5. Collect support from the academic and professional community.
6. Identify opportunities for funding the creation of a new program.
7. Research the of the profession and identify gaps in current course work.

BENEFITS

1. Grows the academic options available to students.
2. Promotes additional job opportunities for students during and post school.
3. Builds upon literature relavent to urban forestry.
4. Establishes an in-house resource for urban forestry researchers.
5. Has the potential to provide support to the campus arborist.

Increase awareness of UW's urban forestry activities & resources

The urban forestry program has implemented numerous activities to strengthen the value of the Urban Forest to the public that could benefit from greater awareness. Information associated with the Brockman Tree Tour, wood salvage program, memorial tree program, and student lead restoration projects could be centrally showcased online to promote greater recognition and support.

TASKS

1. Identify all of the on-campus activities happening associated with the Urban Forest.
2. Update the web content for the Brockman Memorial Tree Tour.
3. Develop online content associated with the wood salvage program.
4. Promote the university's memorial tree program.
5. Develop signage to promote student lead restoration projects.
6. Implement a campaign around Arbor Day (last Friday of April) to promote recent activities.
7. Provide other online tree mapping groups with the University's tree database to be added to their map.

BENEFITS

1. Increases the value of activities on campus.
2. Eases access to Urban Forestry Information.
3. Standardize outreach materials for forestry activities.
4. Facilitates grant writing information needs.
5. Expands the locations where information can be acquired from.

Support the campus as a "Living Laboratory"

A goal of the University of Washington is to utilize its landscape as an extension of the classroom, turning it into a "Living Laboratory. This goal can benefit both students and professors who are learning by doing that produces information of value to academics and university staff.

TASKS

1. Develop a list of potential student projects that would be of benefit to the campus landscape management staff.
2. Identify professors, courses, and staff that could take a leadership role for each project.
3. Pair each project with a potential funding source.
4. Explore project opportunities associated with the Green Seattle Partnership and EarthCorps.
5. Consider using the campus to plant unique trees from southern hardiness zones to test climate change impacts.

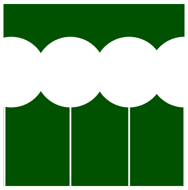
BENEFITS

1. Promotes experiential learning on campus.
2. Gives students the opportunity to gain greater ownership of the campus landscape through projects.
3. Supports an academic goal of the campus.
4. Can provide valuable data to the University for planning and management.

Metrics and Reporting

To track the overall quality of the urban forest and to gauge the progress of the University's Urban Forest goals, metrics have been defined to aid the university in identifing where things are going well, when goals are achieved, and making management and development decisions. The University has defined a range of metrics to evaluate the forest that touch upon the health and density of trees at both the site and campus scale. The University has the means and methods in place to track tree health and diversity but will need to establish a standardized method for collecting tree canopy and ecological value data. The data collection process provides the opportunity for cross-discipline and inter-departmental partnerships with students, staff, and faculty.

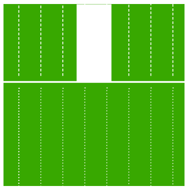
TOOLS + METRIC



CANOPY COVER

In order to track canopy goals the university will need to have regular lidar scans of campus completed and analyzed. As a less accurate method, canopy cover could be estimated using a formula based on a tree's age and its maximum dimension.

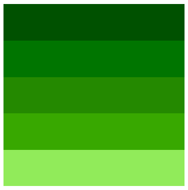
Aerial Lidar
Formula
% Canopy Cover



ECOLOGICAL VALUE

With the use of open-source software it is possible to evaluate an urban forest ecological value in terms of dollars and environmental services. To produce this data the University's existing tree database would need to be formatted to align with I-Trees or a similar software.

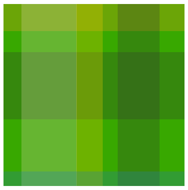
I-Trees
Tree Database
Air Quality
Water Quality
Water Quantity
Habitat



TREE HEALTH

Evaluating the urban forest based on tree health will continue to help the university identify trees and areas that need additional maintenance. Currently this is done on a tree-by-tree basis, but could also include a macro scale analysis using infra-red photography.

Visual Survey
Trunk Formula
Infra-Red Photography
Condition Rating
Level of Photosynthesis



DIVERSITY

Continuing to update the tree database will support tree diversity evaluations. The University will continue to manage and grow the Urban Forest to not exceed 10% of one species or 20% of one genus or 30% of one family.

Tree Database
Species
Tree Types
Age

4

Stewardship & Guidelines

The death of the forest is

the end of our life

Dorothy Stang

The University of Washington takes great pride in their ability to maintain and enhance the urban forest. With oversight from the University Landscape Architect and Manager of Grounds Operations management of each tree is being conducted by the University Arborist with assistance from grounds management crews. Having acquired the title of Tree Campus USA in 2010 the University has continually added to their urban forestry program by establishing an Urban Tree Committee and partnering with students and faculty in tree plantings events and restoration projects. In addition, the University has established a tree salvage program that has grown in stature since its inception with the purchase of a kiln, sawmill and other lumber processing equipment. This management structure is paired with a multi-layered design review process that works with architects, engineers, landscape architects, and construction managers to preserve trees on campus when possible and to promote tree replacement. These processes along with management guidelines are outlined in this chapter to provide designers and builders with the University's tree planting standards and processes.

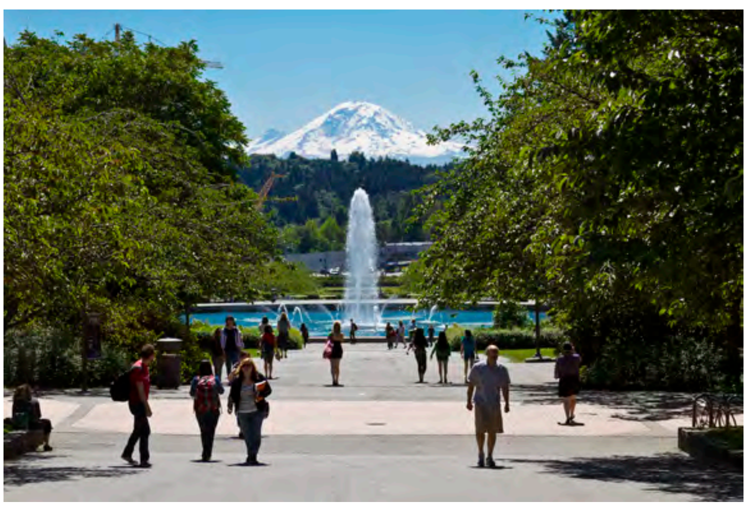
Tree Campus USA

Since 2010, the University of Washington has held the proud distinction of Tree Campus USA. Tree Campus USA recognizes excellence in campus tree management that also engages both the student body and the wider community in the establishment and maintenance of community forests.

Tree Campus USA is a national program created in 2008 to honor colleges and universities for effective campus forest management and for engaging staff and students in conservation goals. The University of Washington achieved the title by meeting Tree Campus USA's five standards, which include:

- **Maintaining a tree advisory committee,**
- **Having a campus tree-care plan,**
- **Dedicated annual expenditures toward trees**
- **Arbor Day observance**
- **Annual Student service-learning projects**

Each year the University of Washington holds an annual planting event that engages students and staff in enhancing an area of campus that could use some additional care. Each events is designed to empower participants by allowing them to gain ownership of the landscape through their active engagement in maintaining and enhancing its legacy.


Design Process

CONCEPT | SCHEMATIC | DETAILS | CONSTRUCTION

The University has established a robust design review process from a projects inception to completion that promotes an open dialogue between designers, the UW community, and project stakeholders. The goal of this process is to align every project with University goals for preserving significant vegetated conditions, maximizing a building's function and capacity while enhancing the overall experience of the University. Every major project must go through this process, so the campus is developed and designed with buy-in from all stakeholders and considered part of a integrated whole.

PRE-CONSTRUCTION

At the start of every project, trees potentially impacted by the project are assessed. All capital projects require the university to hire an third-party Arborist to assess all trees within the construction area. An assessment of current conditions and an appraisal of each tree using the Trunk Formula Method is prepared. Tree protection is a high priority with the University using every measure to protect the root system and canopy of existing trees. For more details into the University's standards, see the "Design Guideline" section at the end of this chapter.

DESIGN REVIEW

All major projects are required to present at both ULAC and UWAC for review and comment during all phases of the design process.

University Landscape Advisory Committee (ULAC)

The University Landscape Advisory Committee plays a key role in helping to preserve and enhance the unique character of the University's outdoor spaces and attain high quality campus environments through reviewing and providing feedback to project teams. The committee is made up of a diverse mix of stakeholders that have specific interest and expertise in topics directly related to landscape architecture, botany, urban design, campus planning, and public health.

University of Washington Architectural Commision (UWAC)

UWAC was established in 1957 to advise the University President and Board on issues related to design, function, performance, and environmental integrity associated with new construction and planning on campus. The commission provides project review for all development that affects the aesthetic character and composition of the university's three campuses.

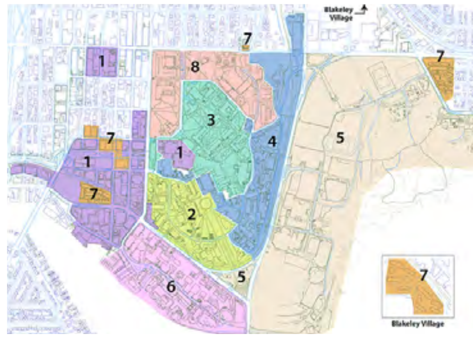
DURING CONSTRUCTION

Once construction begins, the University Arborist, University Landscape Architect, and consulting Landscape Architect conduct site visits, nursery visits, and observes the installation of vegetation for each project. The collaboration within this group makes sure that the design intent is being fully realized while taking into consideration the maintenance requirements and the long-term vision of the landscape. Outside arborist may be brought in for unique circumstances.

POST CONSTRUCTION

After construction has been completed, the campus Arborist conducts all tree management work during and after the warranty period of the contract.

UW Grounds Management



The character of the landscape is a product of the careful management done by UW Grounds Management. Unlike the city, who has multiple departments managing different aspects of the urban forest, UW Grounds Management conducts all maintenance of trees, native areas, lawns, beds, and hardscape along sidewalks, vegetated areas, and parking lots within the Major Institutional Overlay. Grounds Management is a division of Facility Services that consist of an Arborist, mow, irrigation, and landscape crews. The campus is divided into eight maintenance zones for different crews to individually manage. All trees on campus are managed as a whole by the University Arborist with support from third-party arborist for unique projects.

GROUNDS CREWS

As manager of all property within the Major Institutional Overlay the University has a highly trained staff of landscape managers, arborists, and irrigation crews that maintain the campus to a high standard of care. Each maintenance zones consist of one lead with the support of 2 - 4 gardeners.

URBAN FOREST SPECIALIST

The University has a full time ISA certified Arborist on staff that manages all trees on campus with the assistance of an aid. The Arborist conducts all tree pruning, removal, tagging, inoculations, mulching, and staking. During construction projects the University uses a third-party Arborist to conduct a tree analysis for each site to provide recommendations with regards to existing trees on the site. The Office of University Architect works closely with the Arborist in maintaining the vibrancy of the Urban Forest.

CAMPUS TREE ADVISORY COMMITTEE

To provide additional oversight and as a requirement of being a Tree Campus USA, a tree advisory committee has been established to facilitate an open dialogue amongst the various stakeholders of the urban forest: Facility Services Manager, University Arborist, Arboretum Manager, Integrated Pest Management Lead, Center for Urban Horiticulture Staff and University Landscape Architect. They meet once a year to discuss concerns related to protecting and replanting trees that are impacted by construction activities and natural disturbances. This committee offered valuable guidance in the creation of this document through content recommendations and oversight.

Design Guidelines

The preservation and enhancement of a healthy University landscape and urban forest begins with defining project goals through project delivery. In order to establish a standard for landscape implementation, the University of Washington has defined critical design guidelines for consultants to use for creating successful, thriving landscapes on campus. These guidelines range the breath of design implementation from initial site planning to final acceptance. Within the guidelines, construction details are provided to support specific guidelines and to be used by designers in the creation of construction documents. For a complete list of University Design Guidelines, see the Facility Services Design Guidelines (FSDG).

GUIDELINE TOPICS

SITE PLANNING

SITE CONDITIONS

OBSERVATION OF WORK

SUBMITTALS

DELIVERY, STORAGE, AND HANDLING

WORK CHANGES AND CORRECTIONS

SITE PREPARATION

TREE PROTECTION PRODUCTS

TREE AND PLANT PROTECTION

TREE REMOVAL

WEED REMOVAL

TREE REPLACEMENT

COMPACTED SOIL

PLANTING SOIL

SOIL INSTALLATION

SOIL MOISTURE

FINISH GRADES

PLANT SELECTION

PLANT WARRANTY

PLANT QUALITY

PLANTING SEASON

PLANTING LAYOUT

TREE AND SHRUB EXCAVATION

TREE AND SHRUB INSTALLATION

PLANTING OVER STRUCTURE

STAKING AND GUYING

MULCH

COMPOSTED MULCH

WATER

WATERING BAGS

TREE PRUNING

PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION

CLEAN-UP AND DISPOSAL

SUBSTANTIAL COMPLETION

MAINTENANCE DURING WARRANTY PERIOD

END OF WARRANTY - FINAL ACCEPTANCE

SITE PLANNING

- Meetings with the University Landscape Architect and University Architect are encouraged prior to starting the design process.
- An evaluation of the existing trees on a site is required prior to design. This evaluation will be conducted by a third-party Arborist for projects costing greater than 10 million. Otherwise the University Arborist can conduct this analysis.
- All exceptional trees, trees to remain on site and trees for removal will be denoted on the site plan, demolition plan, and tree protection plan.
- A site survey is required for all new projects on campus, conducted by a licensed surveyor. An electronic AutoCAD version of the survey is to be provided to Campus Engineering when completed.

SITE CONDITION

- It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the University Landscape Architect, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.
  - Should subsurface drainage or soil conditions be encountered which would be detrimental to growth or survival of plant material, the Contractor shall notify the University Landscape Architect in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the University Landscape Architect of such conditions, he/she shall remain responsible for plant material under the "Warranty" section of these guidelines.
  - This specification requires that all Planting Soil and Irrigation (if applicable) work be completed and accepted prior to the installation of any plants.
- It is the responsibility of the Contractor to be familiar with the local growing conditions, and if any specified plants will be in conflict with these conditions. Report any potential conflicts, in writing, to the University Landscape Architect.
- Planting operations shall not begin until such time that the irrigation system is completely operational for the area(s) to be planted, and the irrigation system for that area has been preliminarily observed and approved by the University Landscape Architect.
- Actual planting shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practices.
  - No planting shall take place during extremely hot, dry, windy or freezing weather without the approval of the University Landscape Architect.

OBSERVATION OF WORK

- Schedule a pre-construction meeting with the University Landscape Architect at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

- The University Landscape Architect may observe the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.
- The Campus Landscape Architect shall be informed of the progress of the work so the work may be observed at key times in the construction process. The University Landscape Architect shall be afforded sufficient time to schedule visit to the site. Failure of the University Landscape Architect to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.

SUBMITTALS

- Product submittals are required at least 8 weeks prior to the installation of plants and the start of soil work.
- Submit plant growers certificates for all plants indicating that each meets the requirements of the specification, including the requirements of tree quality, to the University Landscape Architect for approval.
- Product Data:
    - Plant Material: Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
    - Product Samples: Submit samples of each product and material where required by the specification to the University Landscape Architect for approval. Label samples to indicate product, characteristics, and locations in the work.
    - Soil Material: Provide a particle size analysis (% dry weight) and USDA soil texture analysis. Soil testing of Planting Soil Mixes shall also include USDA gradation (percentage) of gravel, coarse sand, medium sand, and fine sand in addition to silt and clay.
    - Provide the following other soil properties:
        - pH and buffer pH.
        - Percent organic content by oven dried weight.
        - Nutrient levels by parts per million including: phosphorus, potassium, magnesium, manganese, iron, zinc and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil for optimum growth of the plantings specified.
        - Soluble salt by electrical conductivity of a 1:2 soil water sample measured in Milliohm per cm.
        - Cation Exchange Capacity (CEC).
    - Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the project.

DELIVERY, STORAGE, & HANDLING

- Packaged Materials shall be delivered in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal law if applicable.
- Bulk Materials:
    - Do not dump or store materials near structures, utilities, walkways, and pavements, or on existing turf areas or plants.
    - Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- Deliver bare-root stock plants freshly dug. After digging up, immediately pack root system in a suitable material to keep root system moist until planting.
- Do not prune trees or shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery.
- All plant material shall be transported to planting locations with care to prevent damage. Branches shall be tied back, as necessary, and bark protected with burlap from chafing by ropes at all times.
- No plant material shall be dragged along the ground without proper protection of the root and branches. All planting stock shall be handled by the root ball.
- Protect materials from deterioration during delivery and storage. Adequately protect plants from drying out, exposure of roots to sun, wind or extremes of heat and cold temperatures. If planting is delayed more than 6 hours after delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during the shipping and storage period.
- Topsoil: The contractor is responsible for coordinating blending, shipping, delivery and installation of soils so that the following conditions are met:
    - Components of stockpiled mixes do not segregate or become contaminated
    - Placement and compaction of the soils shall be coordinated to avoid damage to toter installed work, such as roof waterproofing systems, sub-drainage, or irrigation systems.
- Do not deliver more plants to the site than there is space with adequate storage conditions. Provide a suitable remote staging area for plants and other supplies.
    - The University Landscape Architect or Contractor shall approve the duration, method and location of storage of plants.

WORK CHANGES AND CORRECTIONS

- The University Landscape Architect may order changes in the work, and the contract sum adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

- All changes in the work, notifications and contractor's request for information (RFI) shall conform to the contract general condition requirements.

- The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the University Landscape Architect, at the soonest possible time that can be coordinated with other work and seasonal weather demands but not more than 180 (one hundred and eighty) days after notification.

SITE PREPARATION

- Protect structures utilities, pavements, other facilities and existing exterior plants from damage caused by planting operations.

- Provide erosion controls measures to prevent erosions or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkaways.

- Lay out tree, shrub, ground cover, and vine areas as shown in Drawings. Stake locations, outline areas, adjust locates when requested and obtain University Landscape Architect approval of layout before individual plant placement.

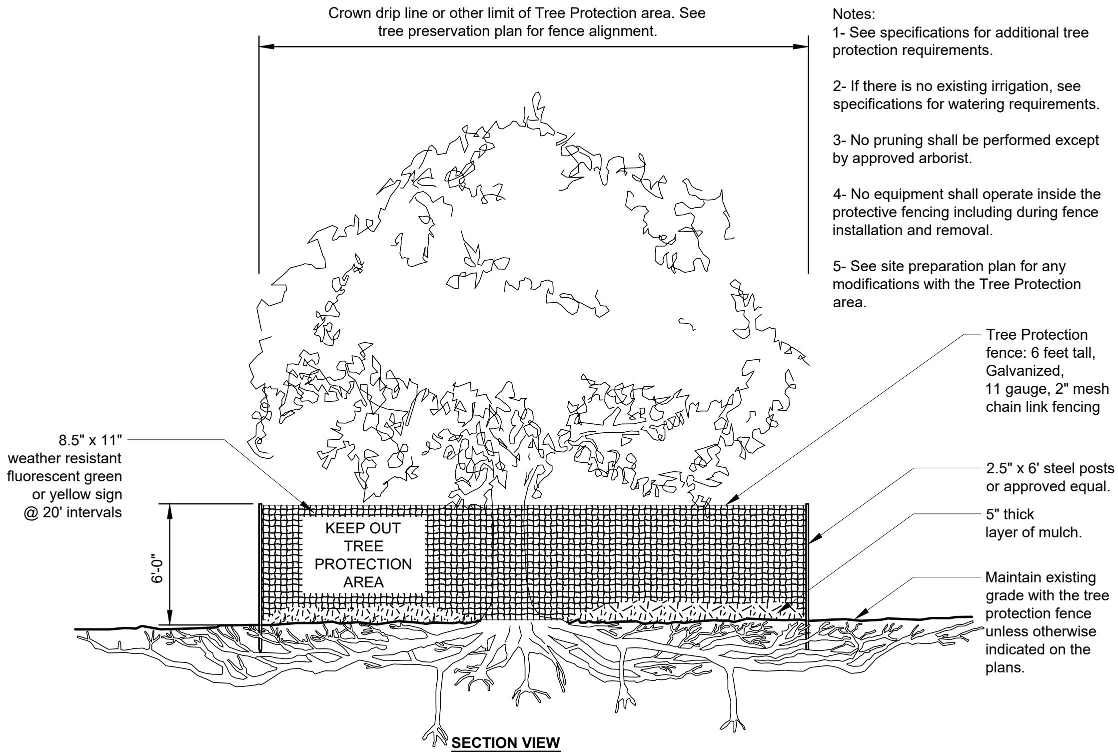
- Place individual trees, shrubs, ground covers, and vines in approved planting areas. University Landscape Architect shall review placement and direct adjustments, as needed. Obtain University Landscape Architect acceptance prior to final installation.

TREE PROTECTION PRODUCTS

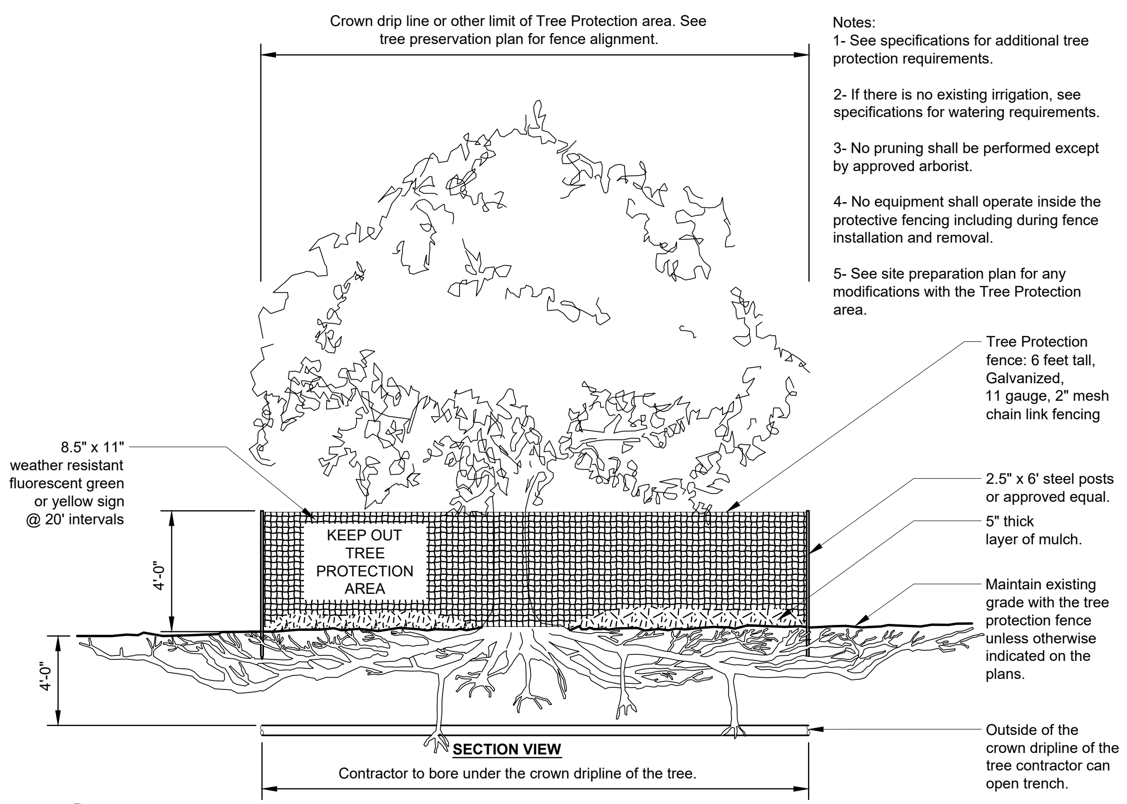
- Tree Protection shall be reviewed and approved by the project Arborist or the University Landscape Architect prior to installation.
  - PROTECTION FENCING shall be equal to the following:
    - CHAIN LINK FENCE: 6 feet tall Galvanized, 11 gauge, 2 inch mesh chain link fencing with nominal 2 1/2 inch diameter galvanized steel posts set in metal frame panels on movable core drilled concrete blocks of sufficient size to hold the fence erect in areas of existing paving to remain.
    - GATES: For each fence type and in each separate fenced area, provide a minimum of one 3 foot wide gate. Gates shall be lockable. The location of the gates shall be approved by the University Landscape Architect.
    - Submit suppliers product data that product meets the requirements for approval.
  - MATTING shall be equal to the following:
    - Matting for vehicle and work protection shall be heavy duty matting designed for vehicle loading over tree roots.
    - Submit suppliers product data that product meets the requirements for approval.
  - GEOGRID shall be equal to the following:
    - Geogrid shall be woven polyester fabric with PVC coating, Uni-axial or biaxial geogrid, inert to biological degradation, resistant to naturally occurring chemicals, alkalis, acids.
    - Submit suppliers product data that product meets the requirements for approval.
  - FILTER FABRIC shall be equal to the following:
    - Filter Fabric shall be non-woven polypropylene fibers, inert to biological degradation and resistant of naturally occurring chemicals, alkalis and acids.
    - Submit suppliers product data that product meets the requirements for approval.
  - PROTECTIVE SIGNAGE shall be equal to the following:
    - Contractor shall post weather-resistant 8.5”x11” fluorescent green or yellow signage on protection fencing at 20 foot intervals warning construction personnel to keep out of tree protection zones.

TREE AND PLANT PROTECTION AREA

- The Tree and Plant Protection Area is defined as all areas indicated on the tree protection plan. Where no limit of the Tree and Plant Protection area is defined on the drawings, the limit shall be the drip line (outer edge of the branch crown) of each tree.
- The Contractor shall not engage in any construction activity, traverse the area to access adjacent areas of the project, or use the Tree Protection area for lunch or any other work breaks without the approval of the University Landscape Architect.
- All tree management activities within the Tree Protection Area will be performed or observed by a Certified Arborist.
- Potentially harmful materials to tree roots can not be stored within twenty (20) feet of protection fencing. Potentially harmful materials include, but are not limited to, petroleum products, cement and concrete materials, cement additives, lime, paints and coatings, waterproofing products, concrete forms coatings, detergents, acids, and cleaning agents.
- Flag all trees and shrubs to be removed by wrapping orange plastic ribbon around the trunk and obtain the University Landscape Architect's approval of all trees and shrubs to be removed prior to the start of tree and shrub removal. After approval, mark all trees and shrubs to be removed with orange paint in a band completely around the base of the tree or shrub 4.5 feet above the ground.
- Flag all trees and shrubs to remain with white plastic ribbon tied completely around the trunk or each tree and on a prominent branch for each shrub. Obtain the University Landscape Architect's approval of all trees and shrubs to be remain prior to the start of tree and shrub removal.
- Prior to any construction activity at the site including utility work, grading, storage of materials, or installation of temporary construction facilities, install all tree protection fencing, Filter Fabric, silt fence, tree protection signs, Geogrid, Mulch and or Wood Chip.
- All trees and landscape requiring protection shall be fertilized and watered by the Contractor until Substantial Completion.
- In the event that construction activity is unavoidable within the Tree and Plant Protection Area, notify the University Landscape Architect and submit a detailed written plan of action for approval. The plan shall include: a statement detailing the reason for the activity including why other areas are not suited; a description of the proposed activity; the time period for the activity, and a list of remedial actions that will reduce the impact on the Tree and Plant Protection Area from the activity. Remedial actions shall include but shall not be limited to the following:
    - When excavation for new construction is required within the Tree Protection Area, hand clear and excavate in a matter that will not cause damage to the tree, roots or soil.
    - Tree branches that interfere with the construction may be tied back or pruned to clear only to the point necessary to complete the work. Other branches shall only be removed when specifically indicated by the University Landscape Architect.



D-1 TREE PROTECTION



D-2 TREE PROTECTION - BORING UNDER CROWN DRIPLINE

TREE REMOVAL

- Trees are to not be dropped with a single cut unless the tree will fall in an area not included in the Tree and Plant Protection Area. No tree to be removed within 50 feet of the Tree and Plant Protection Area shall be pushed over or up-rooted using a piece of grading equipment.
- Protect adjacent paving, soil, trees, shrubs, ground cover plantings and understory plants to remain from damage during all tree removal operations, and from construction operations. Protection shall include the root system, trunk, limbs, and crown from breakage or scarring, and the soil from compaction.
- Grind stumps to ground level, unless there are roots from other trees or vegetation that may be negatively impacted by the practice. Otherwise, (what should be done)
- Prior to tree removal, work with the University Landscape Architect and University Arborist on potentially salvaging the lumber produced from the removed tree.

WEED REMOVAL

- During the construction period, Contractor is required to control any plants that seed in and around the fenced Tree and Plant Protection area at least three times a year.
  - All plants that are not shown on the planting plan or on the Tree and Plant Protection Plan to remain shall be considered as weeds.
- At the end of the construction period provide one final weeding of the Tree and Plant Protection Area.

TREE REPLACEMENT

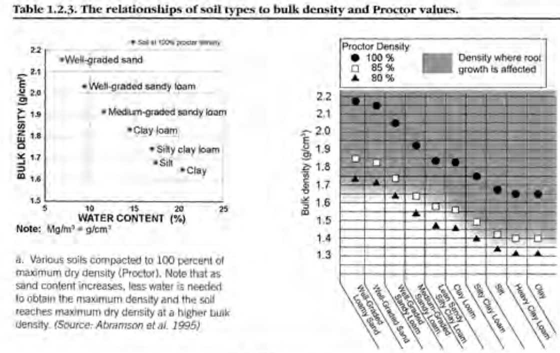
- The requirement for tree replacement is a 1:1 ratio of trees lost to trees required. New trees shall be 2" in caliper minimum.
- When the project cannot replace all trees on-site, the equivalent value of these trees will be charged to the project. The cost to the contractor is based upon the square inches of cross sectional area of trunk measured at 4 ft. above grade, in accordance with the following criteria:
  - $75.00/square inch for trees less than or equal to 6 inch diameter
  - $50.00/square inch for trees greater than 6 inch and less than 18 inch diameter
  - $40.00/square inch for trees greater than or equal to 18 inch diameter

COMPACTED SOIL

- Compacted Soil is defined as soil where the density of the soil is greater that the threshold for root limiting, and further defined in this specification.
- Maintain at the site at all times a soil penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
- The following are threshold levels for compaction as determined by different testing methods:

  - Acceptable Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or in soil with a high organic matter content.
    - Bulk Density Method – Varies by soil type see Chart Below.
    - Standard Proctor Method – 75-85%; soil below 75% is unstable and will settle excessively.
    - Penetration Resistance Method – about 75-250 psi, below 75 psi soil becomes increasingly unstable and will settle excessively.
  - Root limiting Compaction: Root growth is limited with fewer, shorter and slower growing roots.
    - Bulk Density Method – Varies by soil type see Chart Below
    - Standard Proctor Method – above approximately 85%.
    - Penetration Resistance Method – about 300 psi.
  - Excessive Compaction: Roots not likely to grow but can penetrate soil when soil is above field capacity.
    - Bulk Density Method – Varies by soil type see Chart Below.
    - Standard Proctor Method – Above 90%.
    - Penetration Resistance Method – Approximately above 400 psi
- Planting Soil compaction shall be tested at each lift using a penetrometer calibrated to the mock-up soil and its moisture level. The same penetrometer and moisture meter used for the testing of the mock-up shall be used to test installed soil throughout the work.

Table 1.2.3. The relationships of soil types to bulk density and Proctor values.



a. Various soils compacted to 100 percent of maximum dry density (Proctor). Note that as sand content increases, less water is needed to obtain the maximum density and the soil reaches maximum dry density at a higher bulk density. *(Source: Abramson et al. 1995)*

b. Bulk density and levels affecting rooting compared to several Proctor densities. Note that soils to be used for most trees and shrubs should always be compacted to less than 85 percent of maximum dry density. There is limited research comparing bulk density to Proctor value, but a reasonable specification for compacting planting soil would be between 75 and 80 percent, with some settlement expected at that range. Sandier soils can be compacted up to 85 percent, with the exception of well-graded sandy soils. *(Source: Data adapted from Daddow and Warrington 1983, Lichter and Lindsey 1994, and Brady et al. 1999)*

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PLANTING SOIL

- Lawn Planting Soil
    - Lawn planting soil shall consist of 60% Sand and 40% organic amendment by volume, and shall meet or exceed the following specifications:
        - The Sand component shall meet the following specifications with reasonable variations:

          Screen Size Percent (%) Passing

          3/8” 100

          1/4” 95-100

          #10 85-95

          #30 60-75

          #60 50-60

          #100 20-30

          #200 <5
        - pH range between 6.5 and 7.0
        - The Compost (Organic Amendment) Component shall consist of 100% recycled yard waste material or other organic waste material that have been sorted ground up, aerate and aged and shall be fully composted, stable and mature (non-aerobic). The composting process shall be for at least six months time and the organic amendment shall have a uniform dark, soil-like appearance. In addition, the compost shall have the following physical characteristics:
            - Shall have a Carbon to Nitrogen ration of between 20:1 and 40:1
            - Shall be certified by the Process to Further Reduce Pathogens (PFRP) guideline for hot composting as established by the United States Environmental Protection Agency.
            - Shall be fully mature and stable before usage.
            - Shall be screened using a sieve no finer than 1/4” and no greater than 1/2”
            - Based on dry weight of total organic amendment sample: Must comply with the following percent by weight passing:

              Sieve Size Percent (%) Passing

              1/2” (12.7mm) 100

              1/4” (6.35mm) 95-100

              4.76mm 90-95

              2.38mm 75-90

              1.00mm 45-70

              500 micron 0-30
            - Shall have heavy metal concentrations below the WSDA limits as follows:

Metal Type WA State (Max. lb./ac..)
ARSENIC 0.297
CADMIUM 0.079
COBALT 0.594
LEAD 1.981
MERCURY 0.019
MOLYBDENUM 0.079
NICKEL 0.713
SELENIUM 0.055
ZONC 7.32

- Trees, Shrubs, and Ground cover Planting Soil
    - Planting soil shall consist of 67% sandy loam and 33% composted organic material
        - The Sandy Loam or Loamy Sand component shall consist largely of sand, but with enough silt and clay present to give it a small amount of stability and shall meet the following screen analysis:

          Screen Size Percent (%) Passing
          3/8” 100
          1/4” 95-100
          #10 85-95
          #30 60-75
          #60 50-60
          #100 10-20
          #200 0-10
        - Individual sand grains can be seen and felt readily. On squeezing in the hand when dry, it shall form a cast that will not only hold its shape when the pressure is released, but shall withstand careful handling with breaking. The mixed loam shall meet the following:
            - Shall have a pH range of 6.5 - 7.0 with dolomite lime, sulfur, or other amendments, added prior to delivery, as necessary to attain this range, The decomposed organic amendment component shall consist of composed organic materials as described above Lawn Planting Soil.

SOIL INSTALLATION

- As plants are installed, soil shall be evenly spread, cultivated, and lightly compacted to prevent future settlement.
- Planting soil components must be mixed prior to placement in the planting bed or tree pit
- Loosen and scarify sub-grade to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off University of Washington property.

- Apply fertilizer directly to sub-grade before loosening.
- Thoroughly blend planting soil mix off-site before spreading.
- Delay mixing fertilizer with planting soil if planting will not process within a few days
- Mix lime with dry soil before mixing fertilizer
- Spread first lift of planting soil mix to depth of 9 inches over loosened sub-grade. Mix thoroughly into top 4 inches of sub-grade.
- Do not spread if planting soil or sub-grade is frozen, muddy or excessively wet.

SOIL MOISTURE

- Volumetric soil moisture level, in both the planting soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilting point and below field capacity for each type of soil texture within the following ranges.

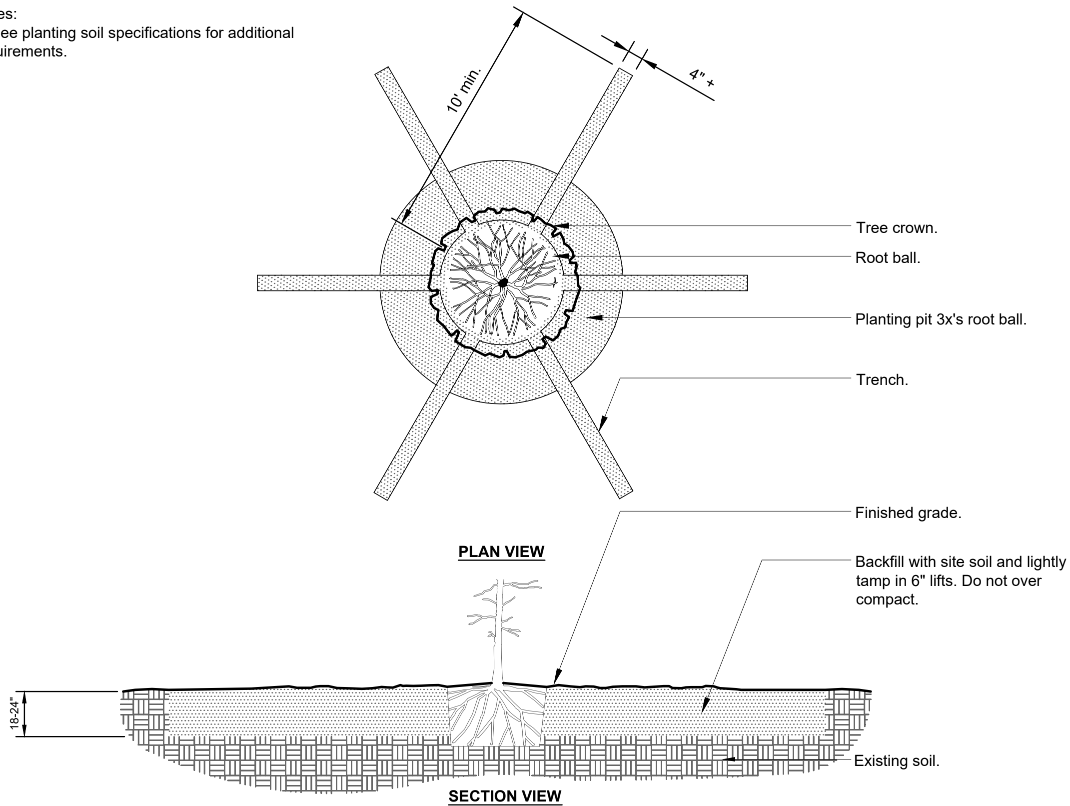
Soil Type	**Permanent Wilting Point**	**Field Capacity**
Sand, Loamy sand, sandy loam	*5% - 8%*	*12% - 18%*
Loam, sandy clay, sandy clay loam	*14% - 25%*	*27% - 36%*
Clay loam, silt loam	*11% - 22%*	*31% - 36%*
- 41%Silty clay, silty clay loam	*22% - 27%*	*38% - 41%*

- Maintain at the site at all times a soil penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
- The Contractor shall confirm the soil moisture levels with a moisture meter. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

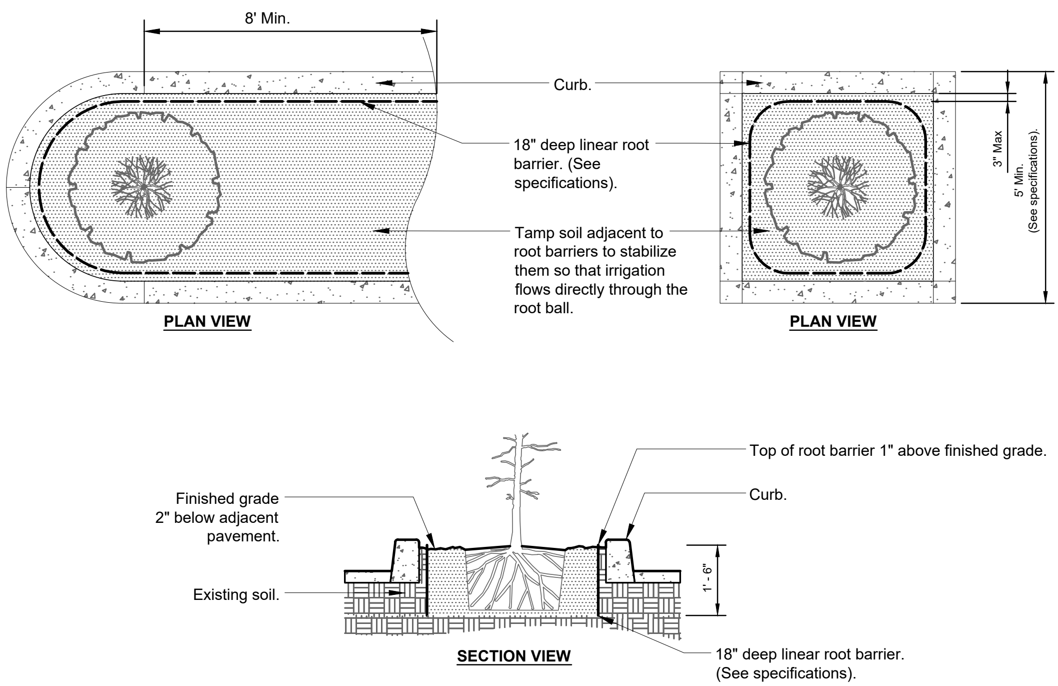
FINISH GRADES

- Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, ensuring the all debris is removed as specified and that the surface is smooth, free draining, contains no low or high spots, and meets specified finish grades. Limit fine grading to areas that can be planted in the immediate future.
  - Grades will not be less than required to meet the finish grades after light rolling and natural settlement.
  - Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.
  - Coordinate finish grading with installation of irrigation system.
  - Before planting, obtain University Landscape Architect acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

Notes:
1- See planting soil specifications for additional requirements.



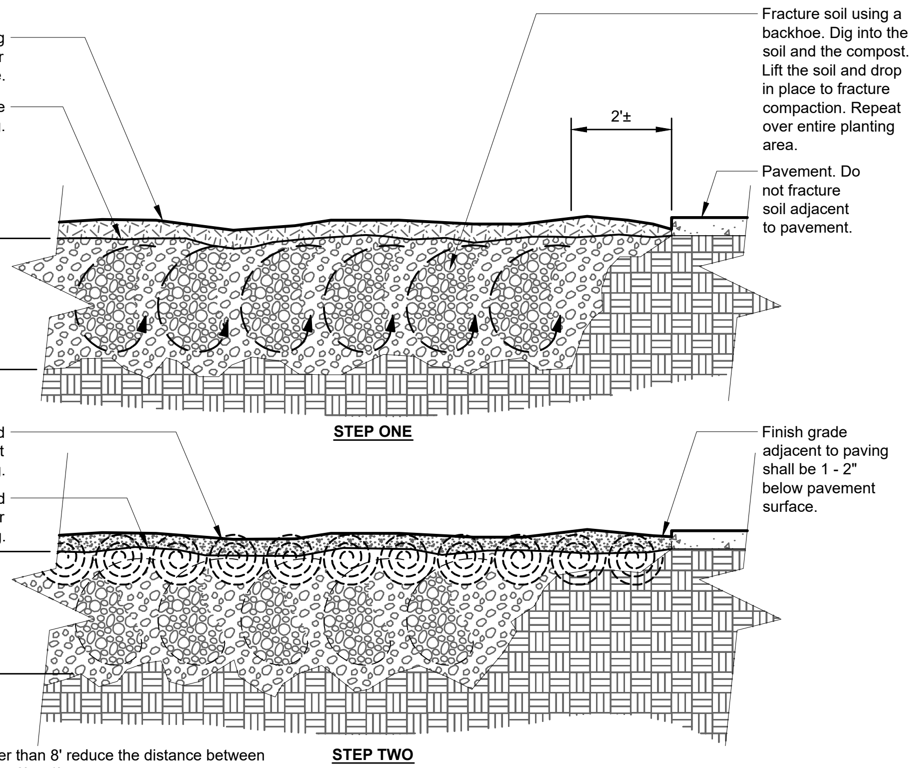
S-X RADIAL TRENCHING



Notes:
1- Root barriers shall be installed per manufacturer's specifications and recommendations.

2- Root barriers shall be installed when root ball is located within 8' of pavement.

S-X ROOT BARRIERS - PARKING LOT ISLANDS

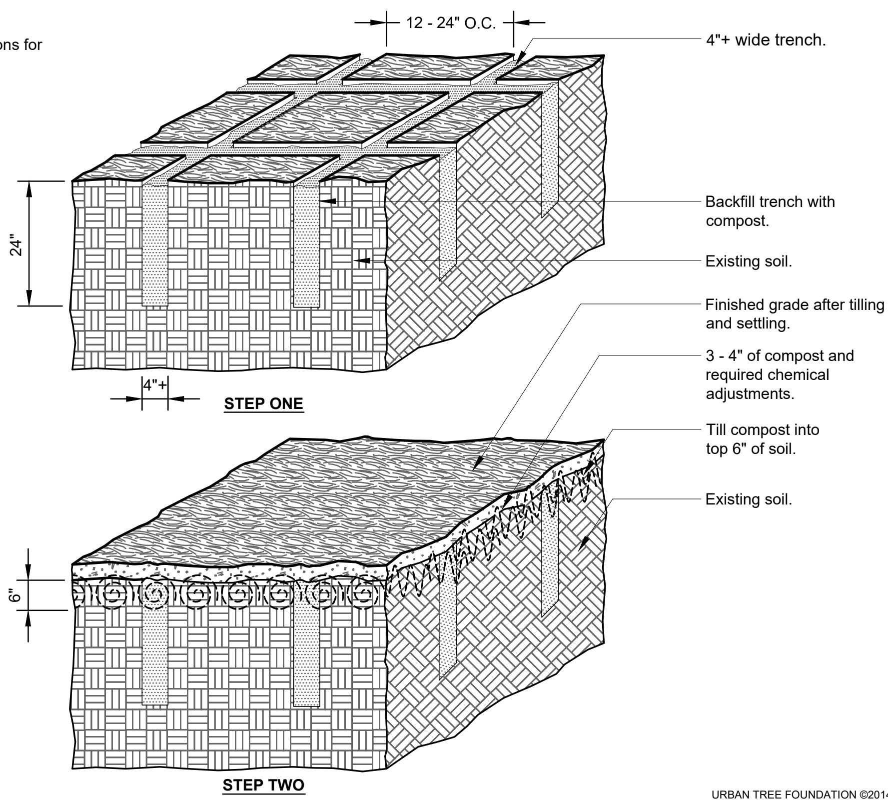


Notes:
1- For planting areas narrower than 8' reduce the distance between paving and soil fracturing from 2' to 1'.

2- See planting soil specification for additional requirements.

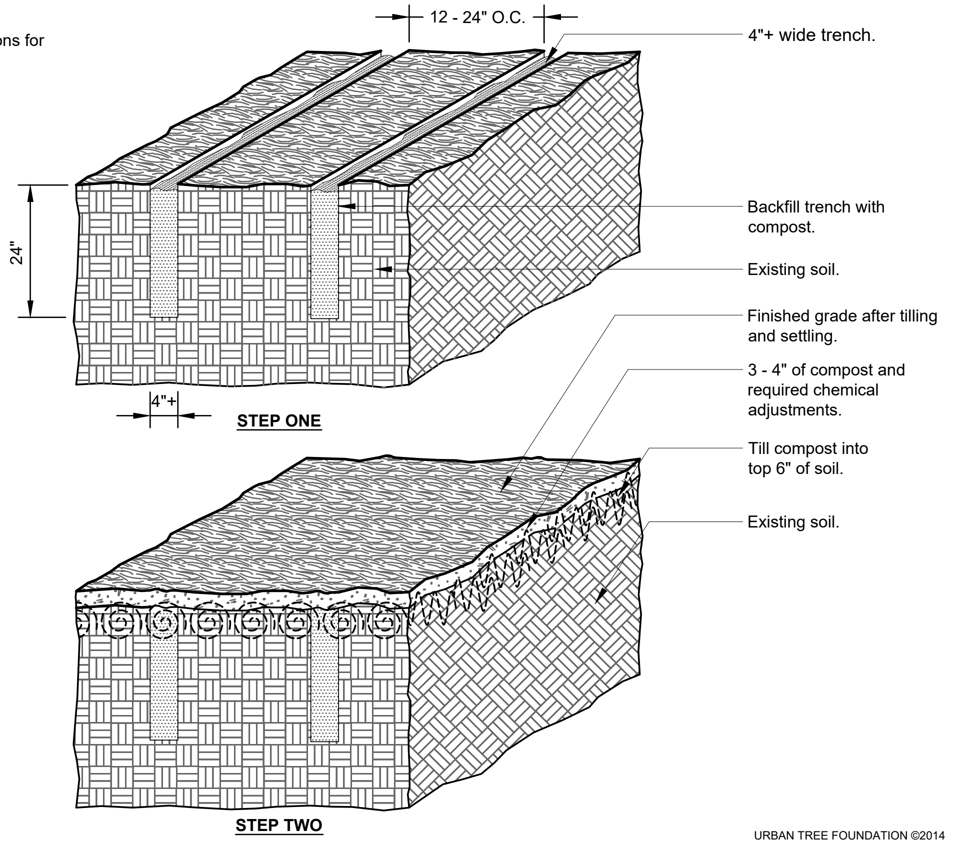
S-X MODIFIED EXISTING SOIL - COMPACTED SUB SOIL (FRACTURING)

Notes:
1- See planting soil specifications for additional requirements.

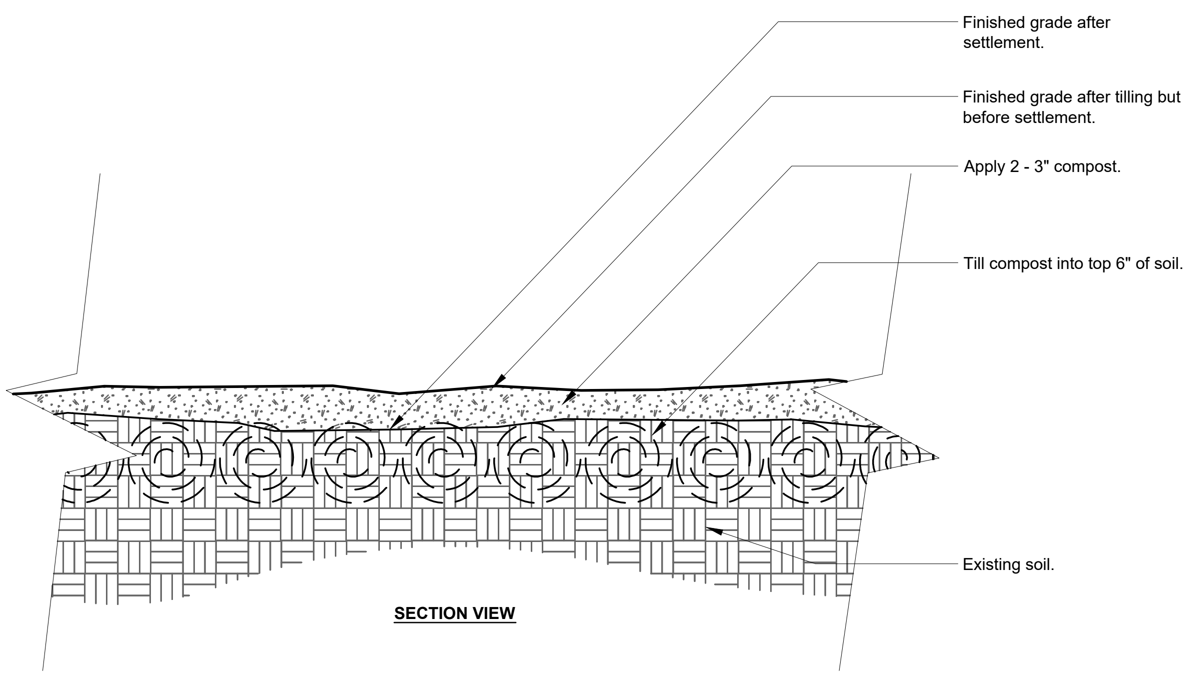


S-X MODIFIED EXISTING SOIL - COMPACTED SUBSOIL (RIPPING)

Notes:
1- See planting soil specifications for additional requirements.

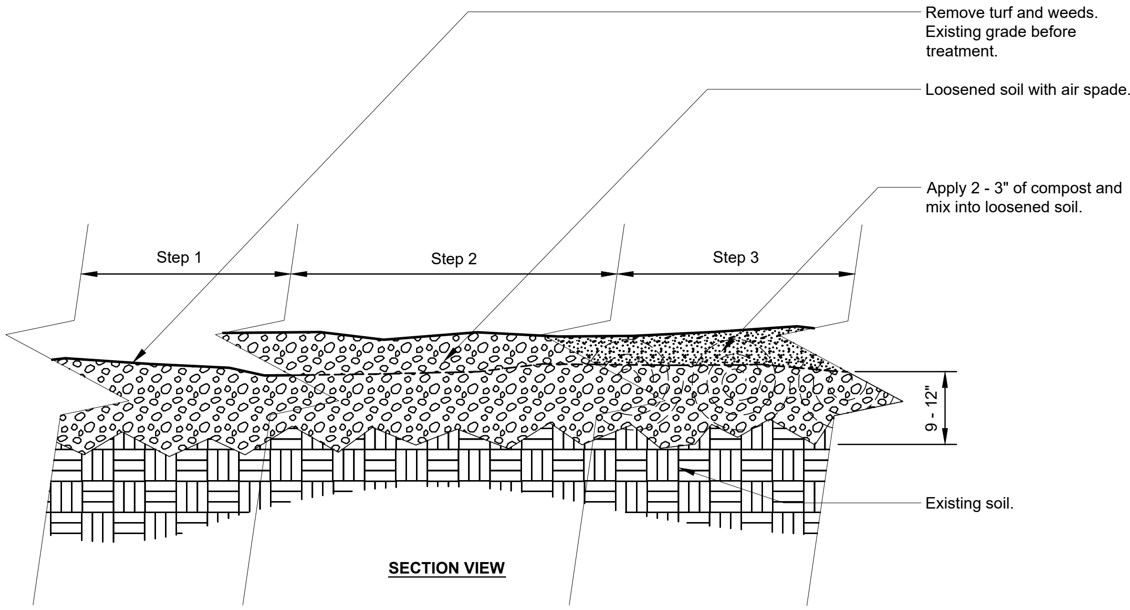


S-x MODIFIED EXISTING SOIL - COMPACTED SUBSOIL (TRENCHING)



Notes:
1- See planting soil specifications for additional requirements.

S-X MODIFIED EXISTING SOIL - COMPACTED SURFACE SOIL



Notes:
1- Prior to the start of work remove all thatch, sod, and/or weeds.

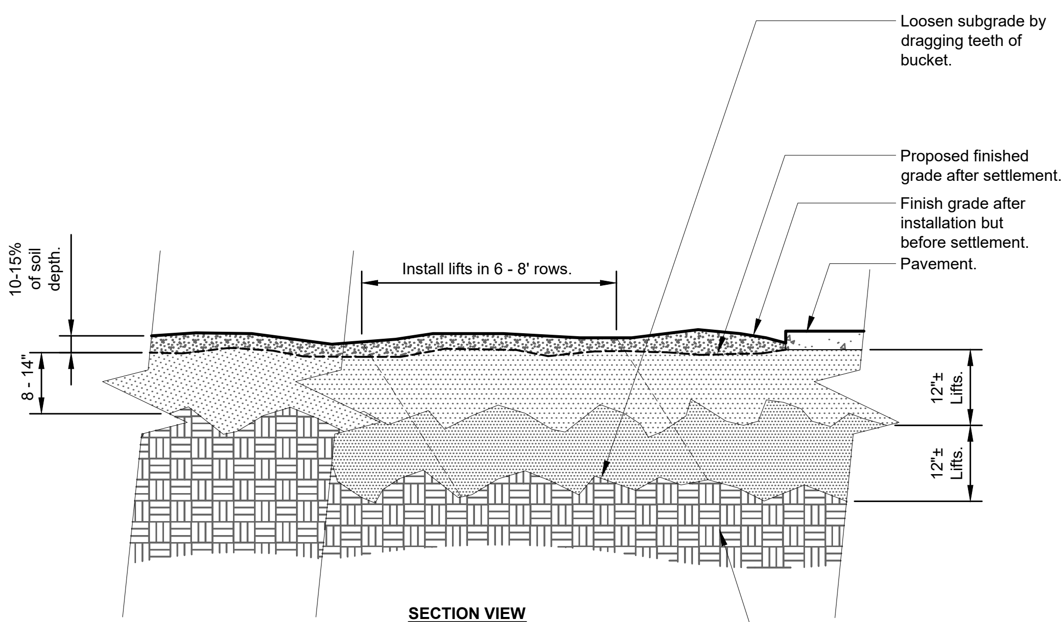
2- Loosen soil with Air Spade or approved equal to a depth of 9 - 12" and work around encountered roots.

3- Apply 2 - 3" of compost over loosened soil. Using an air space mix compost into loosened soil.

4- Water entire root zone at end of each work day.

5- See planting soil specifications for additional requirements.

D-X MODIFIED EXISTING SOIL - COMPACTED SOIL IN TREE DRIPLINE



Notes:
1- Means and methods of soil compaction shall be determined at time of soil mock up.

2- Soil compaction after installation shall be 75 - 250 PSI at soil moisture between field capacity and wilting point.

3- For soil depths see planting soil specifications.

4- See planting soil specification for additional requirements.

S-x MODIFIED EXISTING SOIL - INSTALLED PLANTING MIX

PLANT SELECTION

- The University follows the motto, “Right Tree, Right Place“ strategy for planting new trees on University Property.
- Designers are required to work closely with the University Landscape Architect to identify ideal tree species for projects.
- The University Landscape Architect may review all plants subject to approval of size, health, quality, character, etc. Review or approval of any plant during the process of selection, delivery, installation and establishment period shall not prevent that plant from later rejection in the event that the plant quality changes or previously existing defects become apparent that were not observed.
- All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.
- When requested by the University Landscape Architect, submit photographs of plants or representative samples of plants. Photographs shall be legible and clearly depict the plant specimen. Each submitted image shall contain a height reference, such as a measuring stick. The approval of plants by the University Landscape Architect via photograph does not preclude the University Landscape Architect right to reject material while on site.
- University Landscape Architect may inspect plant material at nursery or off-site holding area prior to arrival on site. Plant materials shall be inspected by the University Landscape Architect after arrival on site. Notify the University Landscape Architect four business days prior to the proposed arrival of plant materials on site. Arrange for adequate manpower and equipment on site at the time of plant material inspection and installation to unload and handle material and provide a complete staked layout during inspection. Plants not meeting the requirements herein specified or matching approved representative photographs shall be immediately removed from the project and replaced by the Contractor at no additional cost to the University of Washington.
- All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by genus, species, variety and cultivar.
- All plant species substitution request, or size needs to be submitted to the University Landscape Architect, for approval, prior to purchasing the proposed substitution. Requests shall also include sources of plants found that may be of a smaller or larger size, or a different shape or habit than specified, or plants of the same genus and species but different cultivar origin, or which may otherwise not meet the requirements of the specifications, but which may be available for substitution.

PLANT WARRANTY

- Contractor shall furnish imported plants materials, move and/or remove on-site plants specified, and install all plant materials indicated on the drawings, provide maintenance and care of plant material, cleanup, and provide warranty as defined in this section.
- Contractor is required to replace defective work and defective plants. The University Landscape Architect shall make the final determination if plants meet these specifications or that plants are defective.

- Defective includes, but is not limited to, the following:
    - Death or unsatisfactory growth, except for defects resulting from incidents that are beyonds contractors control.
    - Structural failures including planting falling or blowing over.
    - Faulty performance of tree stabilization or edging.
    - Deterioration of metals, metal finishes and other materials beyond normal weathering.
- Warranty period is 1 year from the data of substantial completion.
- When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty, shall terminate at one time.
- All plants shall be warrantied to meet all the requirements for plant quality at installation in this specification. Defective plants shall be defined as plants not meeting these requirements. The University Landscape Architect shall make the final determination that plants are defective.
- The warranty of all replacement plants shall extend for an additional one-year period from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended warranty period, the Owner's Representative may elect one more replacement items or credit for each item. These tertiary replacement items are not protected under a warranty period.
- At the end of the warranty period, the University Landscape Architect shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.
- All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.

PLANT QUALITY

- Plants are to possess normal well-developed branch systems; sound crotches; vigorous fibrous root systems; trees with straight trunks and leader intact; densely foliated free from defects, disfiguring knots, suncald or windburn injuries, disfigurement and abrasion of the bark, disease, pests, eggs and larvae. Freshly dug at time of delivery.

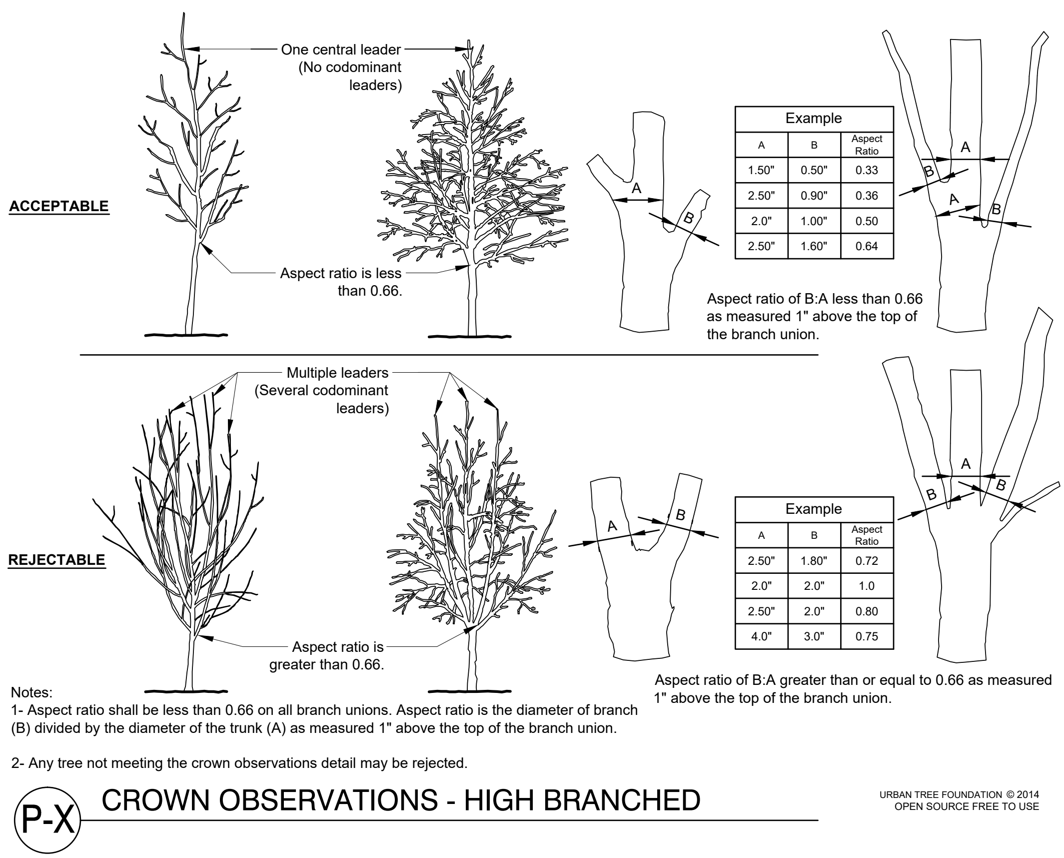
- Do not use plants harvested from the wild, from native stands, from established landscape planting or not grown in a nursery unless otherwise approved by the University Landscape Architect.
- All trees to be field grown. No potted or bagged plants will be accepted. The University recommends using plant stock that is balled and burlapped over or container plants instead of bare-root.
- Provide plant material grown within 1 hardiness zone of the project for a minimum of 3 years prior to the date of planting unless approved otherwise by the University Landscape Architect.

above soil line

- Plants shall be healthy with the color, shape, size and distribution of trunk, stems, branches, buds and leaves normal to the plant type specified. Tree quality above the soil line shall comply with the project Crown Acceptance details and the following:
    - Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar pruned to a central and dominant leader.
    - Crown specifications do not apply to plants that have been specifically trained in the nursery as topiary, espalier, multi-stem, clump, or unique selections such as contorted or weeping cultivars.
    - Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or over watering as indicated by wilted, shriveled, or dead leaves.
    - Branches: Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.
    - Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds that penetrate to the wood (properly made pruning cuts, closed or not, are acceptable and are not considered wounds), sunburned areas, conks (fungal fruiting bodies), wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury).
    - Temporary branches, unless otherwise specified, can be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper. These branches should be no greater than 3/8-inch diameter. Clear trunk should be no more than 40% of the total height of the tree.
    - Trees shall have one central leader, unless a different form is specified. If the leader was headed, a new leader (with a live terminal bud) at least one-half the diameter of the pruning cut shall be present.
- All graft unions, where applicable, shall be completely closed without visible sign of graft rejection. All grafts shall be visible above the soil line.
- Trunk caliper and taper shall be sufficient so that the lower five feet of the trunk remains vertical without a stake. Auxiliary stake may be used to maintain a straight leader in the upper half of the tree.
- Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

at or below soil line

- Plant roots shall be normal to the plant type specified. Root observations shall take place without impacting tree health. Root quality at or below the soil line shall comply with the project Root Acceptance details and the following:
  - The roots shall be reasonably free of scrapes, broken or split wood.
  - The root system shall be reasonably free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Wounds resulting from root pruning used to produce a high quality root system are not considered injuries.
  - A minimum of three structural roots reasonably distributed around the trunk (not clustered on one side) shall be found in each plant. Root distribution shall be uniform throughout the root ball, and growth shall be appropriate for the species.
  - The root collar shall be within the upper 2 inches of the substrate/soil. Two structural roots shall reach the side of the root ball near the top surface of the root ball. The grower may request a modification to this requirement for species with roots that rapidly descend, provided that the grower removes all stem girdling roots above the structural roots across the top of the root ball.
  - The root system shall be reasonably free of stem girdling roots over the root collar or kinked roots from nursery production practices.
  - At time of observations and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

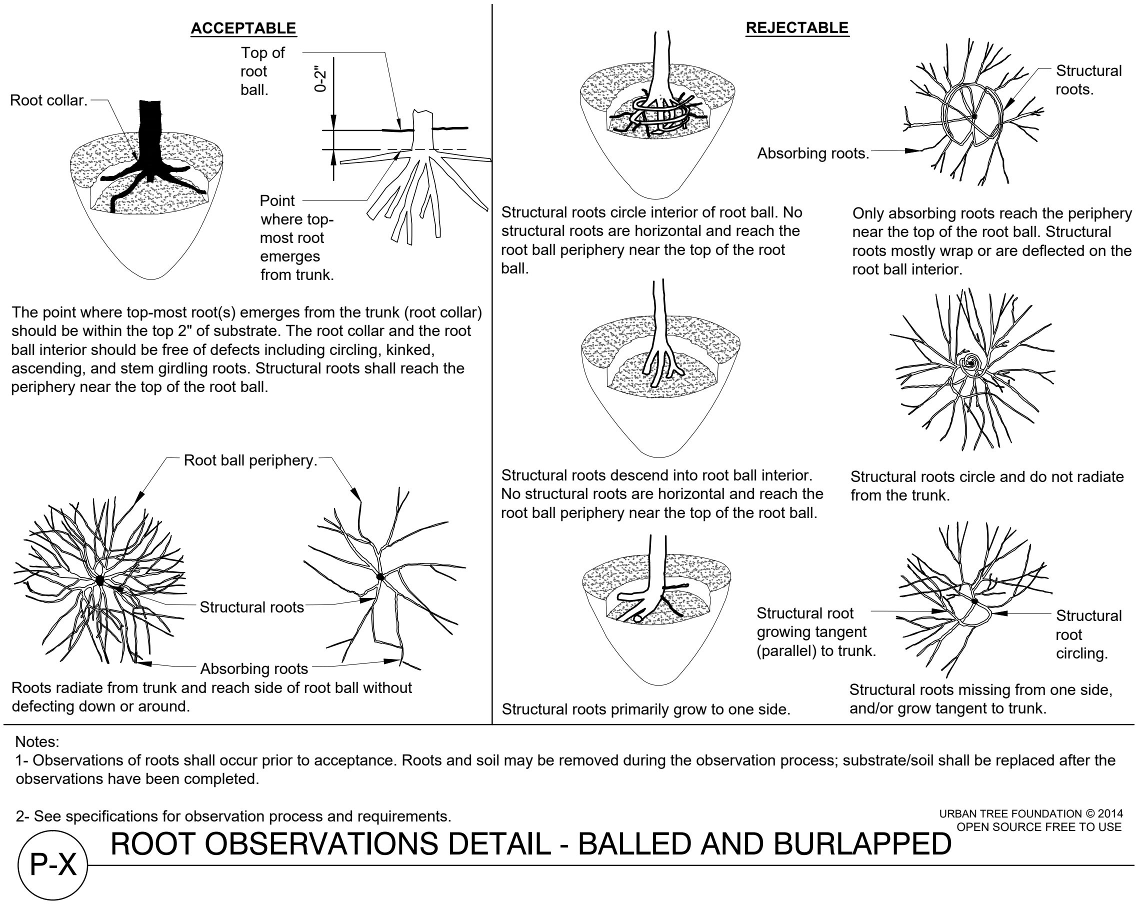


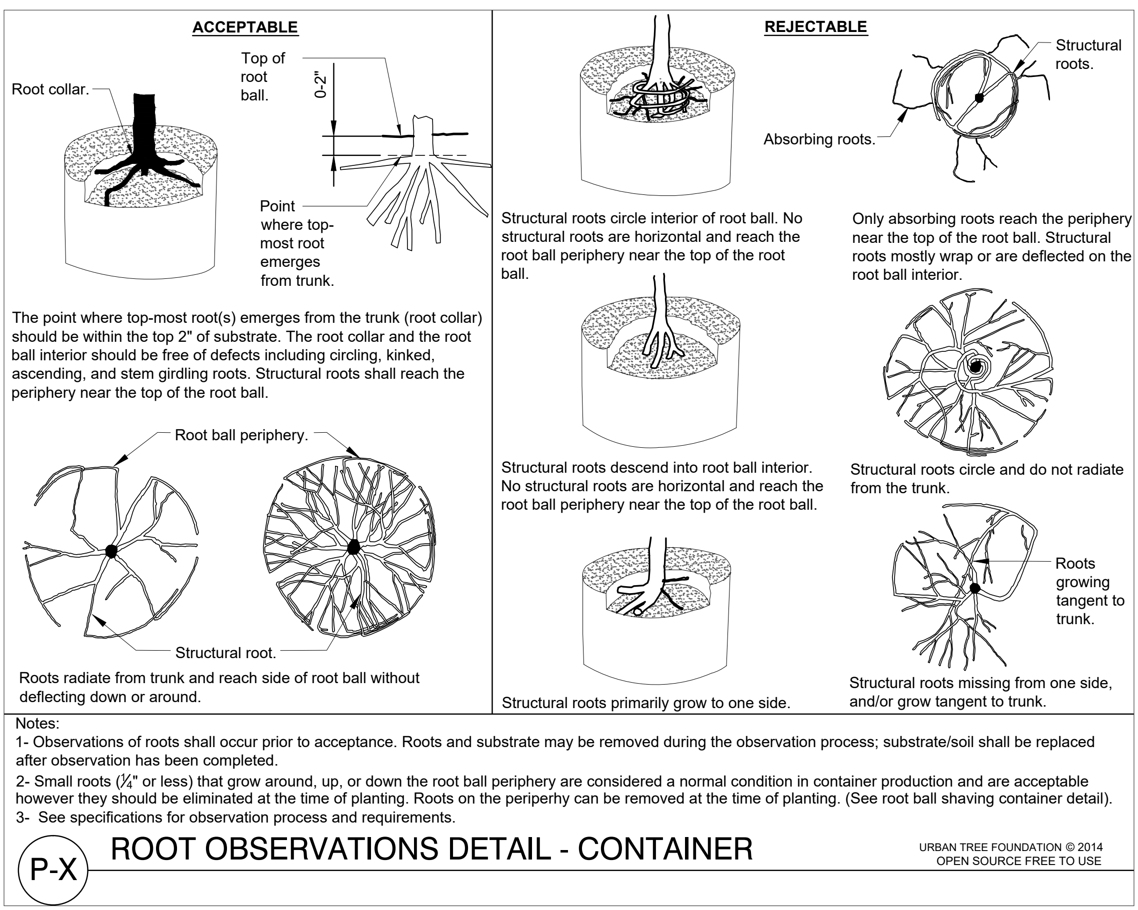
Example (Acceptable)

A	B	Aspect Ratio
1.50"	0.50"	0.33
2.50"	0.90"	0.36
2.0"	1.00"	0.50
2.50"	1.60"	0.64

Example (Rejectable)

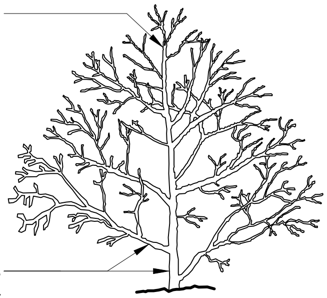
A	B	Aspect Ratio
2.50"	1.80"	0.72
2.0"	2.0"	1.0
2.50"	2.0"	0.80
4.0"	3.0"	0.75


ACCEPTABLE
Top of root ball.
0-2"
Root collar.
Point where top-most root emerges from trunk.
The point where top-most root(s) emerges from the trunk (root collar) should be within the top 2" of substrate. The root collar and the root ball interior should be free of defects including circling, kinked, ascending, and stem girdling roots. Structural roots shall reach the periphery near the top of the root ball.
Root ball periphery.
Structural roots
Absorbing roots
Roots radiate from trunk and reach side of root ball without defecting down or around.
REJECTABLE
Structural roots.
Absorbing roots.
Structural roots circle interior of root ball. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.
Only absorbing roots reach the periphery near the top of the root ball. Structural roots mostly wrap or are deflected on the root ball interior.
Structural roots descend into root ball interior. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.
Structural roots circle and do not radiate from the trunk.
Structural root growing tangent (parallel) to trunk.
Structural root circling.
Structural roots primarily grow to one side.
Structural roots missing from one side, and/or grow tangent to trunk.
Notes:
1- Observations of roots shall occur prior to acceptance. Roots and soil may be removed during the observation process; substrate/soil shall be replaced after the observations have been completed.
2- See specifications for observation process and requirements.
URBAN TREE FOUNDATION © 2014
OPEN SOURCE FREE TO USE
P-X
ROOT OBSERVATIONS DETAIL - BALLED AND BURLAPPED

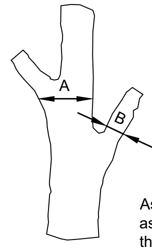

ACCEPTABLE
Top of root ball.
0-2"
Root collar.
Point where top-most root emerges from trunk.
The point where top-most root(s) emerges from the trunk (root collar) should be within the top 2" of substrate. The root collar and the root ball interior should be free of defects including circling, kinked, ascending, and stem girdling roots. Structural roots shall reach the periphery near the top of the root ball.
Root ball periphery.
Structural root.
Roots radiate from trunk and reach side of root ball without deflecting down or around.
REJECTABLE
Structural roots.
Absorbing roots.
Structural roots circle interior of root ball. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.
Only absorbing roots reach the periphery near the top of the root ball. Structural roots mostly wrap or are deflected on the root ball interior.
Structural roots descend into root ball interior. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.
Structural roots circle and do not radiate from the trunk.
Roots growing tangent to trunk.
Structural roots primarily grow to one side.
Structural roots missing from one side, and/or grow tangent to trunk.
Notes:
1- Observations of roots shall occur prior to acceptance. Roots and substrate may be removed during the observation process; substrate/soil shall be replaced after observation has been completed.
2- Small roots (¼" or less) that grow around, up, or down the root ball periphery are considered a normal condition in container production and are acceptable however they should be eliminated at the time of planting. Roots on the periperhy can be removed at the time of planting. (See root ball shaving container detail).
3- See specifications for observation process and requirements.
P-X
ROOT OBSERVATIONS DETAIL - CONTAINER
URBAN TREE FOUNDATION © 2014
OPEN SOURCE FREE TO USE

ACCEPTABLE

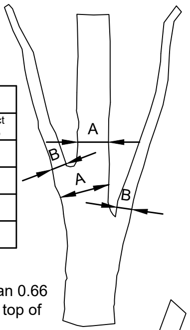
One central leader (No codominant leaders)



Aspect ratio is less than 0.66.



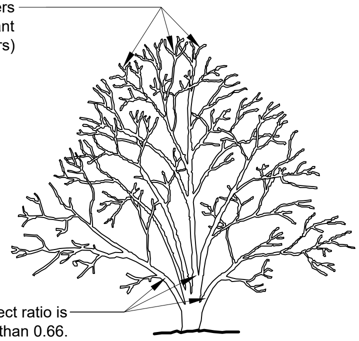
Example		
A	B	Aspect Ratio
1.50"	0.50"	0.33
2.50"	0.90"	0.36
2.0"	1.00"	0.50
2.50"	1.60"	0.64



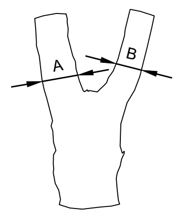
Aspect ratio of B:A less than 0.66 as measured 1" above the top of the branch union.

REJECTABLE

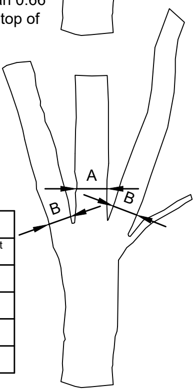
Multiple leaders (Several codominant leaders)



Aspect ratio is greater than 0.66.



Example		
A	B	Aspect Ratio
2.50"	1.80"	0.72
2.0"	2.0"	1.0
2.50"	2.0"	0.80
4.0"	3.0"	0.75



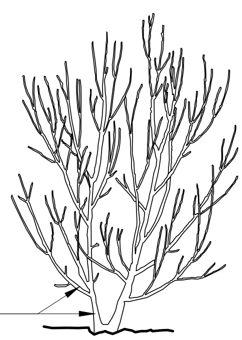
Aspect ratio of B:A greater than or equal to 0.66

Notes:
1- Aspect ratio shall be less than 0.66 on all branch unions. Aspect ratio is the diameter of branch (B) divided by the diameter of the trunk (A) as measured 1" above the top of the branch union.

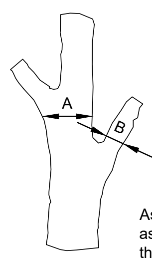
2- Any tree not meeting the crown observations detail may be rejected.

P-X CROWN OBSERVATIONS - LOW BRANCHED

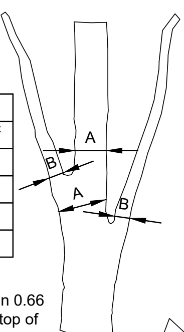
ACCEPTABLE



Aspect ratio is less than 0.66.



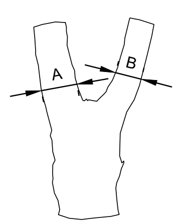
Example		
A	B	Aspect Ratio
1.50"	0.50"	0.33
2.50"	0.90"	0.36
2.0"	1.00"	0.50
2.50"	1.60"	0.64



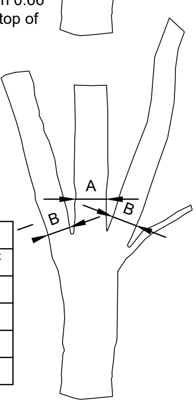
Aspect ratio of B:A less than 0.66 as measured 1" above the top of the branch union.

REJECTABLE

Aspect ratio is greater than 0.66.



Example		
A	B	Aspect Ratio
2.50"	1.80"	0.72
2.0"	2.0"	1.0
2.50"	2.0"	0.80
4.0"	3.0"	0.75



Aspect ratio of B:A greater than or equal to 0.66 as measured 1" above the top of the branch union.

Notes:
1- Aspect ratio shall be less than 0.66 on all branch unions. Aspect ratio is the diameter of branch (B) divided by the diameter of the trunk (A) as measured 1" above the top of the branch union.

2- Any tree not meeting the crown observations detail may be rejected.

P-X CROWN OBSERVATION DETAIL - MULTI

PLANTING SEASON

- Planting shall only be performed when weather and soil conditions are suitable for planting the materials specified. Install plants during the planting time as described below unless otherwise approved in writing by the University Landscape Architect. In the event that the Contractor request planting outside the dates of the planting season, approval of the request does not change the requirements of the warranty
    - Spring Planting: March 15 - June 1
    - Fall Planting: September 15 to November 1
- Weather Limitations: No planting shall take place during extremely hot, dry, windy or freezing weather without the approval of the University Landscape Architect. Plant when existing and forecasted weather conditions permit planting to be performed when beneficial and optimal results may be obtained.
- Plant trees, shrubs and other plants after finish grades are established and before planting sod areas unless otherwise approved by the University Landscape Architect.

PLANTING LAYOUT

- Notify the University Landscape Architect, one (1) week prior to layout. Layout all individual tree and shrub locations. Place plants above surface at planting location or place a labeled stake at planting location. Layout bed lines with paint for the Owner's Representative's approval. Secure the Owner's Representative's acceptance before digging and start of planting work.
- When applicable, plant trees before other plants are installed.
- Plants are not precise objects and minor adjustments in the layout will be required as the planting plan is constructed. These adjustments may not be apparent until some or all of the plants are installed. Make adjustments as required by the University Landscape Architect including relocating previously installed plants.

TREE AND SHRUB EXCAVATION

- Excavate circular pits with side sloped inward. Leave center area raised slightly to support root ball and assist in drainage. Scarify sides of plant pit smeared or smoother during excavation.
    - Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
    - Excavate 36" depth for trees prior to planting and 24" depth for shrubs as a baseline or deeper if needed to accommodate rootball depth and raised center area for planting pedestal.

- Fill excavation with water and allow to percolate away before positioning trees and shrubs. Notify University Landscape Architect, in writing, immediately of any subsurface drainage, ponding, or other soil conditions which the Contractor or Arborist consider detrimental to growth and survival of plant materials.
- Unsatisfactory Condition: Examine sub-grade, verify elevation, observe conditions under which work is to be performed and notify University Landscape Architect of any unsatisfactory or adverse conditions such as but not limited to:
    - Unexpected rock, utilities, or other obstructions detrimental to plant material are encountered in excavation.
    - Subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- Do not proceed until unsatisfactory conditions have been corrected.

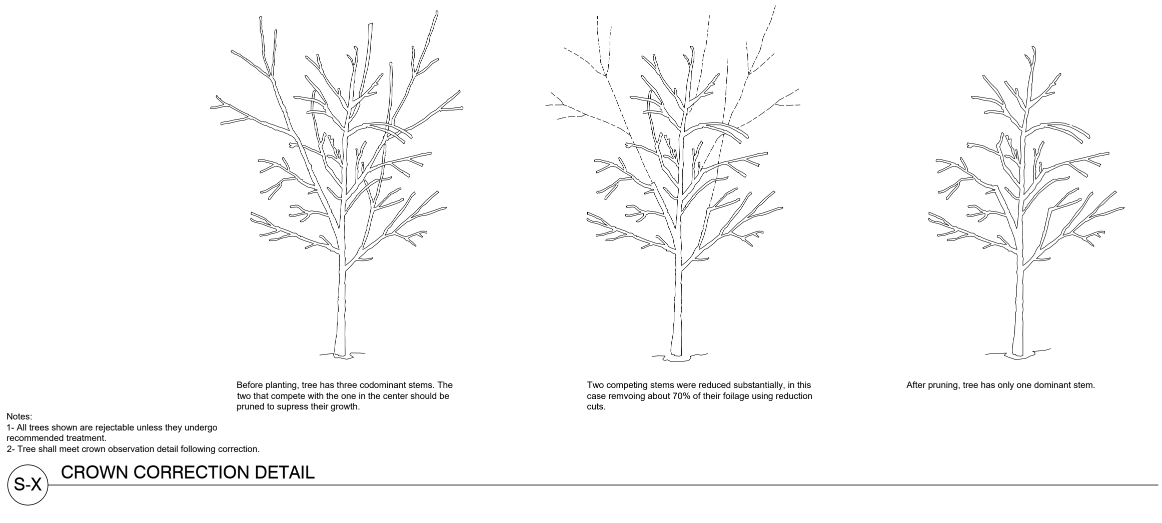
TREE AND SHRUB INSTALLATION: GENERAL

- Plant trees, shrubs and other plants after finish grades are established and before planting sod areas unless otherwise approved by the University Landscape Architect.
- Due to digging techniques or improper transplanting, plants may arrive from the nursery with the root flare buried. The Landscape Contractor must take care to make sure that the original root flare is planted at the proper grade.
- The root system of each plant, regardless of root ball package type, shall be observed by the Contractor, at the time of planting to confirm that the roots meet the requirements for plant root quality under the Plant Quality section. The Contractor shall undertake at the time of planting, all modifications to the root system required by the University Landscape Architect to meet these quality standards.
    - Modifications, at the time of planting, to meet the specifications for the depth of the root collar and removal of stem girdling roots and circling roots may make the plant unstable or stress the plant to the point that the Owner's Representative may choose to reject the plant rather than permitting the modification.
    - Any modifications required by the University Landscape Architect to make the root system conform to the plant quality standards outlined in the Plant Quality section.
    - The University Landscape Architect may reject the plant if the root modification process makes the tree unstable or if the tree is not healthy at the end of the warranty period. Such plants shall still be covered under the warranty.
    - The Contractor remains responsible to confirm that the grower has made all required root modifications noted during any nursery observations.

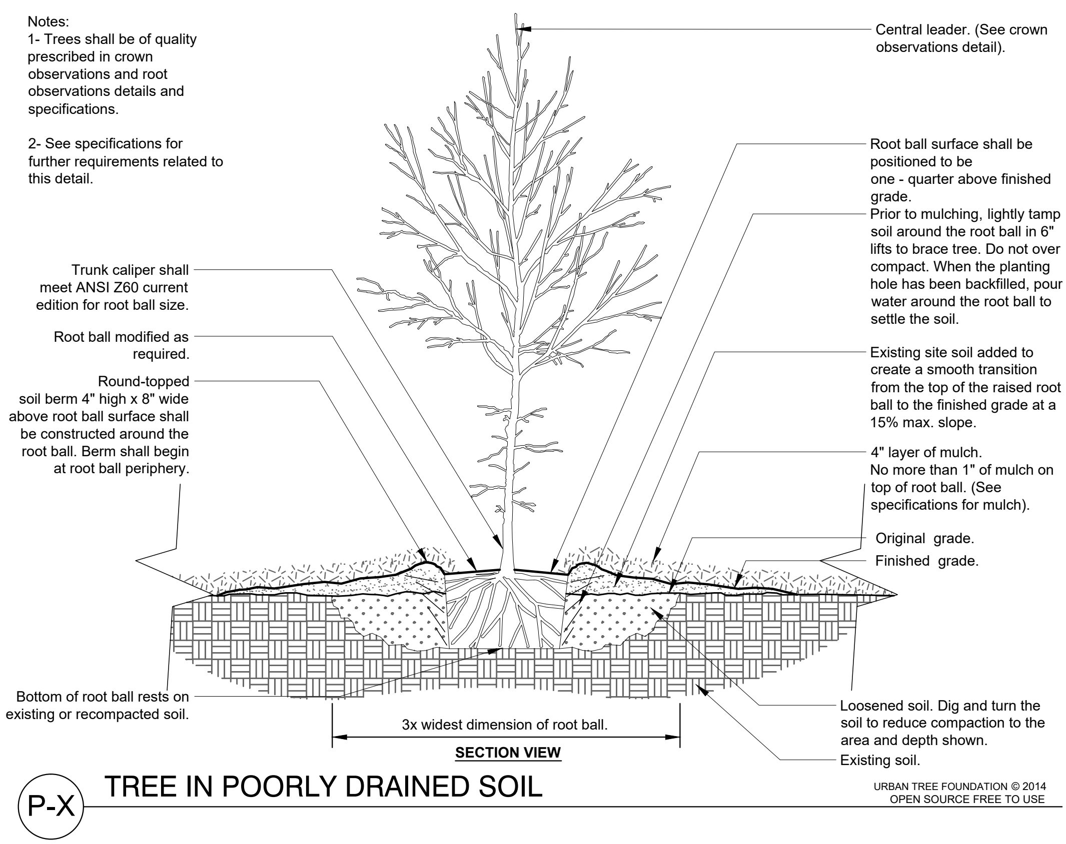
- Container and Boxed Root Ball Shaving: The outer surfaces of ALL plants in containers and boxes, including the top, sides and bottom of the root ball shall be shaved to remove all circling, descending, and matted roots. Shaving shall be performed by a certified arborist using suitable equipment that is capable of making clean cuts on the roots. Shaving shall remove a minimum of one inch of root mat or up to 2 inches as required to remove all root segments that are not growing reasonably radial to the trunk.
- Exposed Stem Tissue after Modification: The required root ball modifications may result in stem tissue that has not formed trunk bark being exposed above the soil line. If such condition occurs, wrap the exposed portion of the stem in a protective wrapping with a white filter fabric. Secure the fabric with biodegradable masking tape. DO NOT USE string, twine, green nursery ties or any other material that may girdle the trunk if not removed.
- Excavation of the Planting Space: Using hand tools or tracked mini-excavator, excavate the planting hole into the Planting Soil to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball or to the size indicated on the drawing or as noted below.
    - For trees and shrubs planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 12 inches over a distance of more than 10 feet radius from each tree, or 5 feet radius from each shrub, the soil around the root ball shall be loosened as defined below or as indicated on the drawings.
        - The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.
        - Loosening is defined as digging into the soil and turning the soil to reduce the compaction. The soil does not have to be removed from the hole, just dug, lifted and turned. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.
    - If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees and shrubs planted in soil areas that are NOT tilled or otherwise modified.
    - The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
    - If motorized equipment is used to deliver plants to the planting area over exposed planting beds, or used to loosen the soil or dig the planting holes, all soil that has been driven over shall be tilled to a depth of 6 inches.
    - Mulch: Apply 2-inch average thickness of organic mulch to planting bed. Feather mulch to zero inches at root collar, beginning at 4 inches from trunks and stems. In no circumstances should mulch contact exposed portions of trunk flare.

PLANTING OVER STRUCTURE

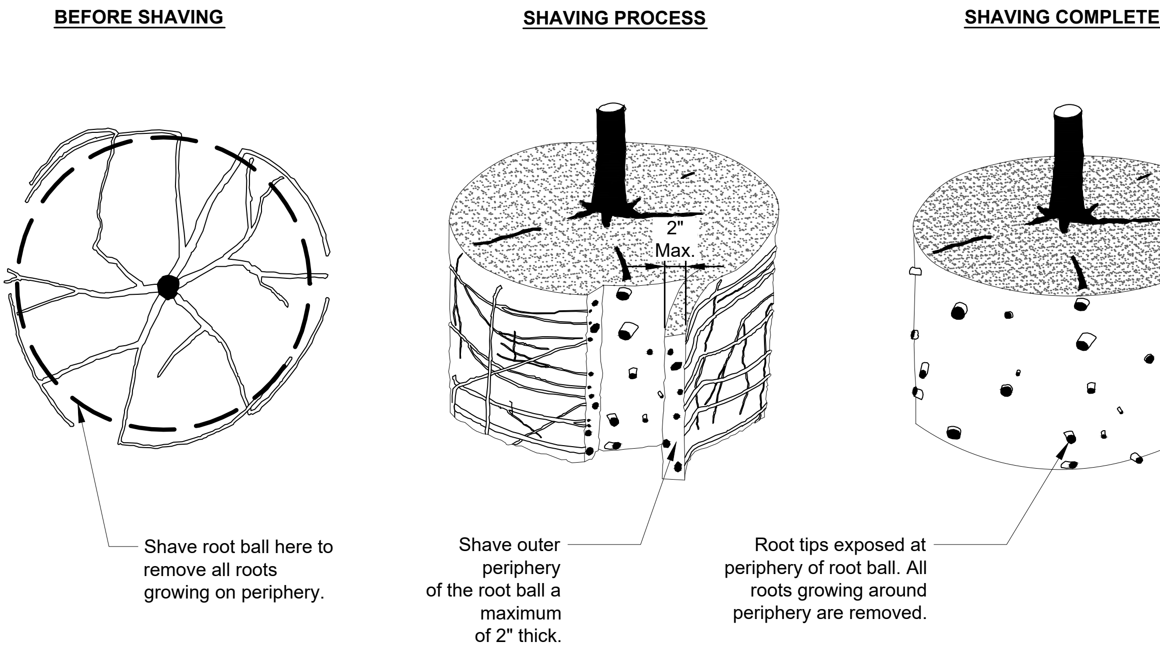
- Verify prior to plant installation:
    - Verify that all protection board and membranes are in place
    - Verify that roof waterproofing membrane has been tested to ensure that there are no leaks, and continually protected after this testing.
    - If areas of membrane have been left exposed, waterproofing must be retested prior to installation of overburden.
- Do not proceed until unsatisfactory conditions have been corrected.



CROWN CORRECTION DETAIL



TREE IN POORLY DRAINED SOIL



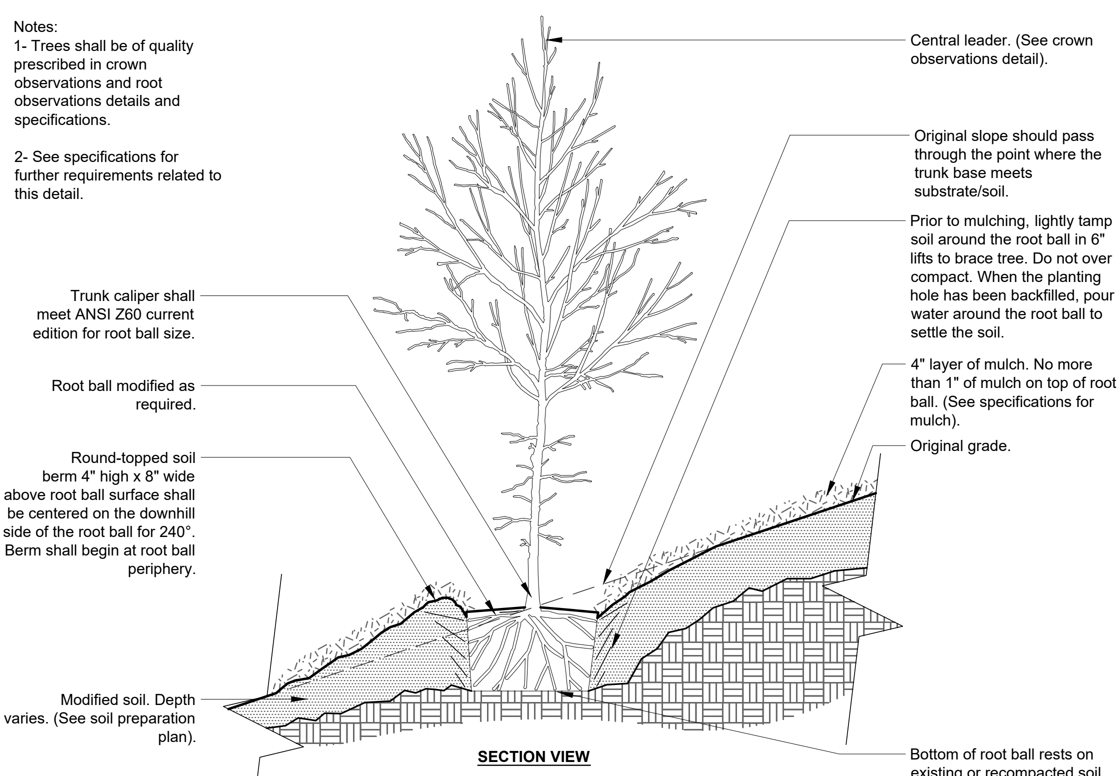
Notes:
1- Shaving to be conducted using a sharp blade or hand saw eliminating no more than needed to remove all roots on the periphery of root ball.

2- Shaving can be performed just prior to planting or after placing in the hole.

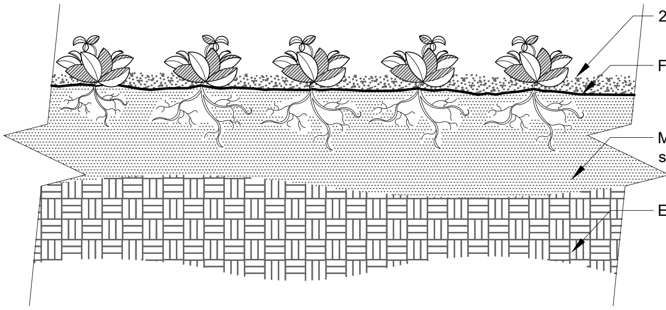
P-X ROOT BALL SHAVING CONTAINER DETAIL

Notes:
1- Trees shall be of quality prescribed in crown observations and root observations details and specifications.

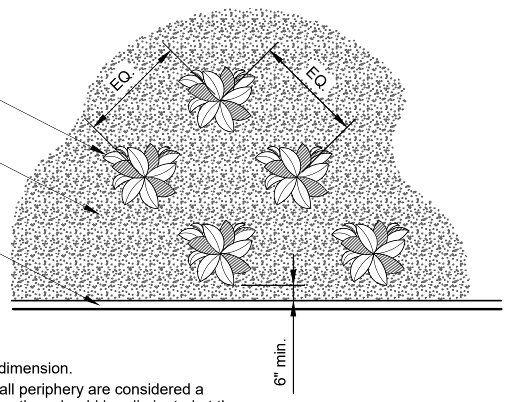
2- See specifications for further requirements related to this detail.



P-X TREE ON SLOPE 5% (20:1) TO 50% (2:1) (EXISTING SOIL MODIFIED)



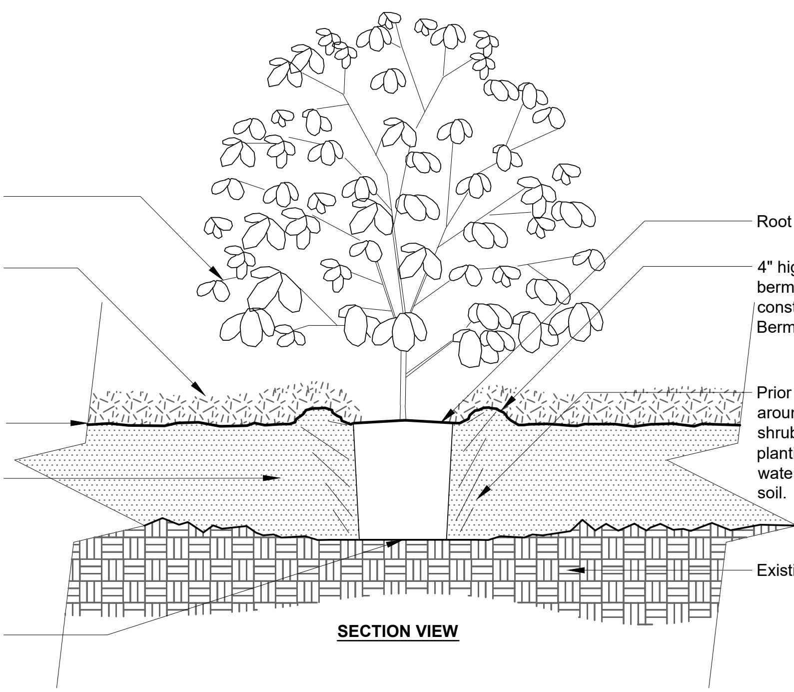
SECTION VIEW



PLAN

Notes:
1- See planting legend for groundcover species, size, and spacing dimension.
2- Small roots (¼" or less) that grow around, up, or down the root ball periphery are considered a normal condition in container production and are acceptable however they should be eliminated at the time of planting. Roots on the periperhy can be removed at the time of planting. (See root ball shaving container detail).
3- Settle soil around root ball of each groundcover prior to mulching.

P-X GROUNDCOVER



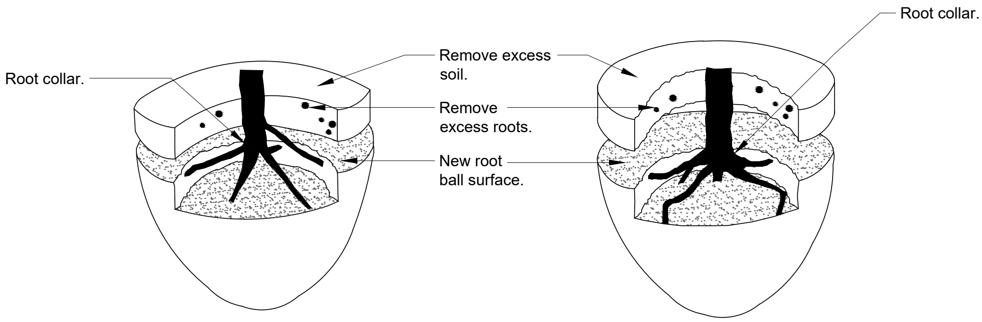
SECTION VIEW

Notes:
1- Shrubs shall be of quality prescribed in the root observations detail and specifications.

2- See specifications for further requirements related to this detail.

P-X SHRUB - MODIFIED SOIL

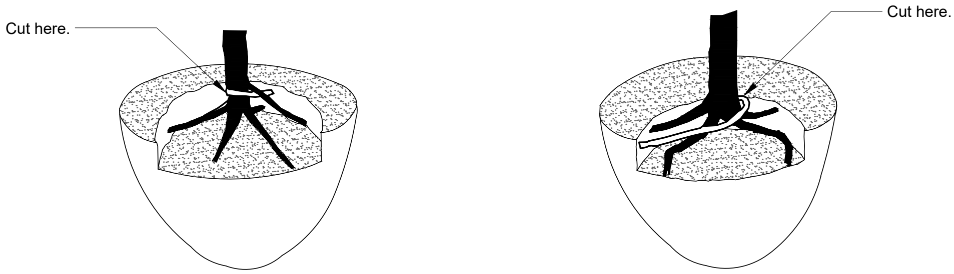
Step 1 - Remove soil and roots over the root collar.



Tree planted too deeply in root ball. Remove excess soil and roots to meet root inspection detail.

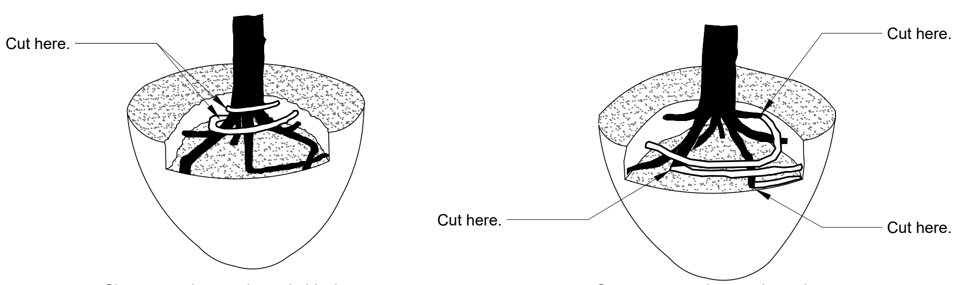
Tree planted too deeply in root ball. Remove excess soil and roots to meet root inspection detail.

Step 2 - Remove defects.



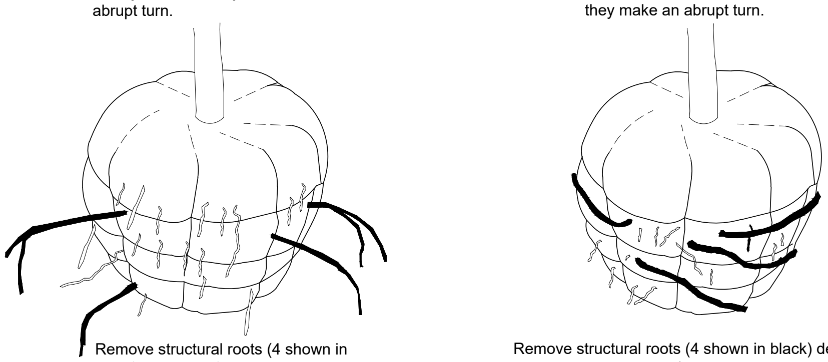
Five structural (large) roots shown in black. Remove structural (white) root wrapping root collar.

Four structural roots shown in black. Remove root (white) growing over structural roots.



Six structural roots shown in black. Remove structural roots (white) growing over root collar by cutting them just before they make an abrupt turn.

Seven structural roots shown in black. Remove structural roots (white) growing around or over root collar by cutting them just before they make an abrupt turn.



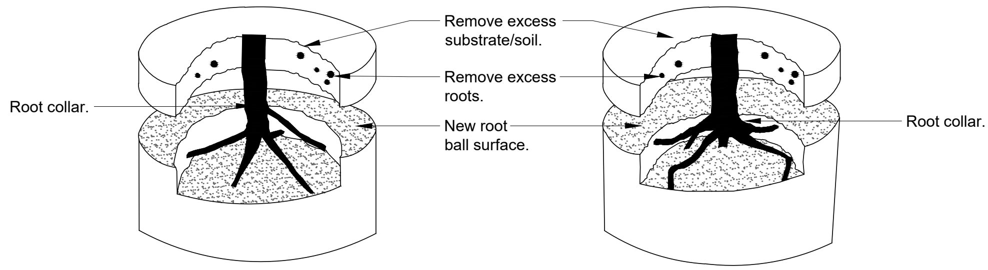
Remove structural roots (4 shown in black) extending from root ball.

Remove structural roots (4 shown in black) deflected on root ball periphery. Small roots (¼" or less) at the periphery of the root ball are not defined as defects and do not need to be removed.

Notes:
1- All trees shown are rejectable unless they undergo recommended correction.
2- First step 1, then step 2. Adjust hole depth to allow for the removal of excess soil and roots over the root collar.
3- Roots and soil may be removed during the correction process; substrate/soil shall be replaced after the correction has been completed.
4- Trees shall pass root observations detail following correction.

P-X ROOT CORRECTION DETAIL - BALLED AND BURLAPPED

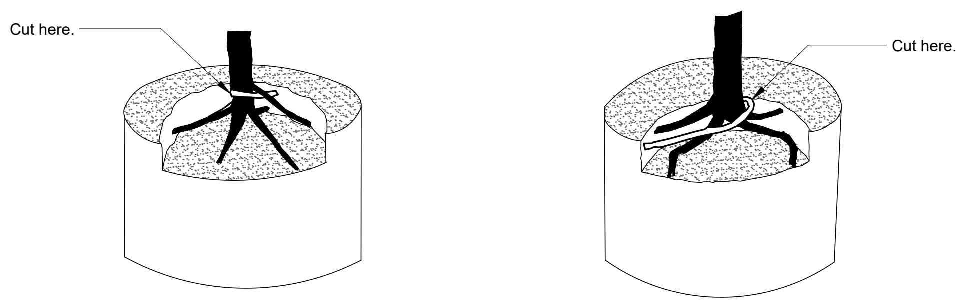
Step 1 - Remove substrate over root collar.



Tree planted too deeply in root ball. Remove excess substrate and roots to meet root inspection detail.

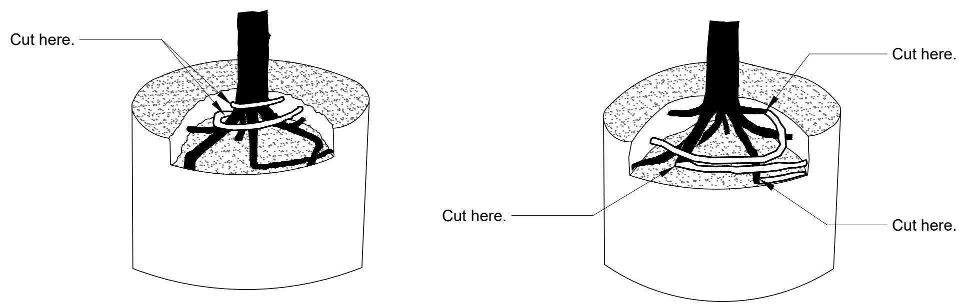
Tree planted too deeply in root ball. Remove excess substrate and roots to meet root inspection detail.

Step 2 - Remove defects.



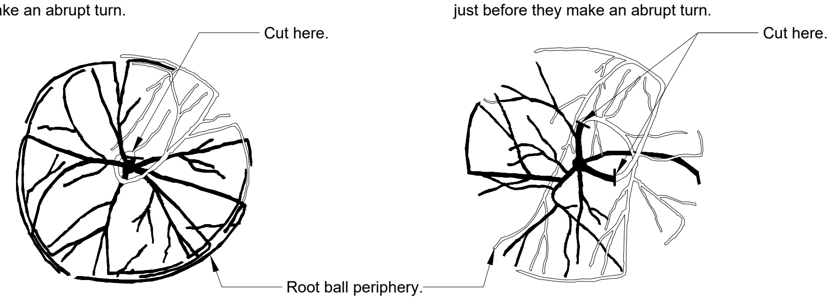
Five structural (large) roots shown in black. Remove structural root (white) wrapping root collar.

Four structural roots shown in black. Remove root (white) growing over structural roots.



Six structural roots shown in black. Remove roots (white) growing over root collar by cutting them just before they make an abrupt turn.

Seven structural roots shown in black. Remove structural roots (white) growing around or over root collar by cutting them just before they make an abrupt turn.



Cut structural root just before it makes abrupt turn. Pruning cut should be made tangent (parallel) to the trunk.

Cut structural roots just before they make abrupt turn by cutting tangent (parallel) to the trunk (two cuts shown).

Notes:
1- All trees shown are rejectable unless they undergo recommended correction.
2- First Step 1, then Step 2. Roots and soil may be removed during the correction process; substrate/soil shall be replaced after correction has been completed.
3- Trees shall meet root observations detail following correction.
4- Small roots (1/4" or less) on the periphery of the root ball are common with container plant production. These small roots are not defined as "defects" and can be addressed at the time of installation (See root ball shaving container detail).

P-X **ROOT CORRECTION DETAIL - CONTAINER**

STAKING AND GUYING

- Tree guying to be flat woven polypropylene material, 3/4 inch wide, and 900 lb. break strength. Product to be approved by the University Landscape Architect.

- Stakes shall be lodge pole stakes free of knots, holes, cross grain, and other defects at diameters and lengths appropriate to the size of plant as required to adequately support the plant.

- Below ground anchorage systems to be constructed of 2 x 2 dimensional untreated wood securing (using 3 inch long screws) horizontal portions to 4 feet long vertical stakes driven straight into the ground outside the root ball.

- Stake or guy trees as detailed immediately after planting. Trees shall stand plumb after staking or guying.

- Do not stake or guy trees unless specifically required by the Contract Documents, or in the event that the Contractor feels that staking is the only alternative way to keep particular trees plumb.

    - The University Landscape Architect shall have the authority to require that trees are staked or to reject staking as an alternative way to stabilize the tree.

    - Trees that required heavily modified root balls to meet the root quality standards may become unstable. The University Landscape Architect may choose to reject these trees rather than utilize staking to temporarily support the tree.

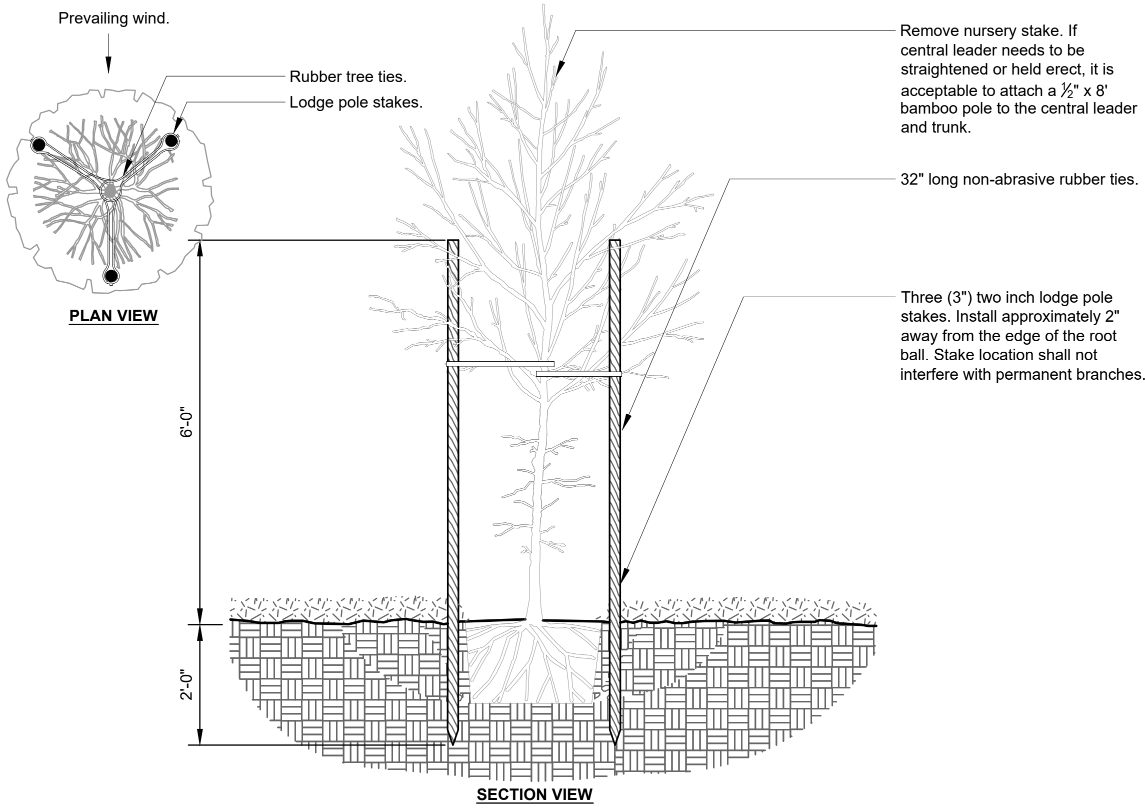
- Trees that are guyed shall have their guys and stakes removed after one full growing season or at other times as required by the University Landscape Architect.

- Tree guying shall utilize the tree staking and guying materials specified. Guying to be tied in such a manner as to create a minimum 12-inch loop to prevent girdling. Refer to manufacturer's recommendations and the planting detail for installation.

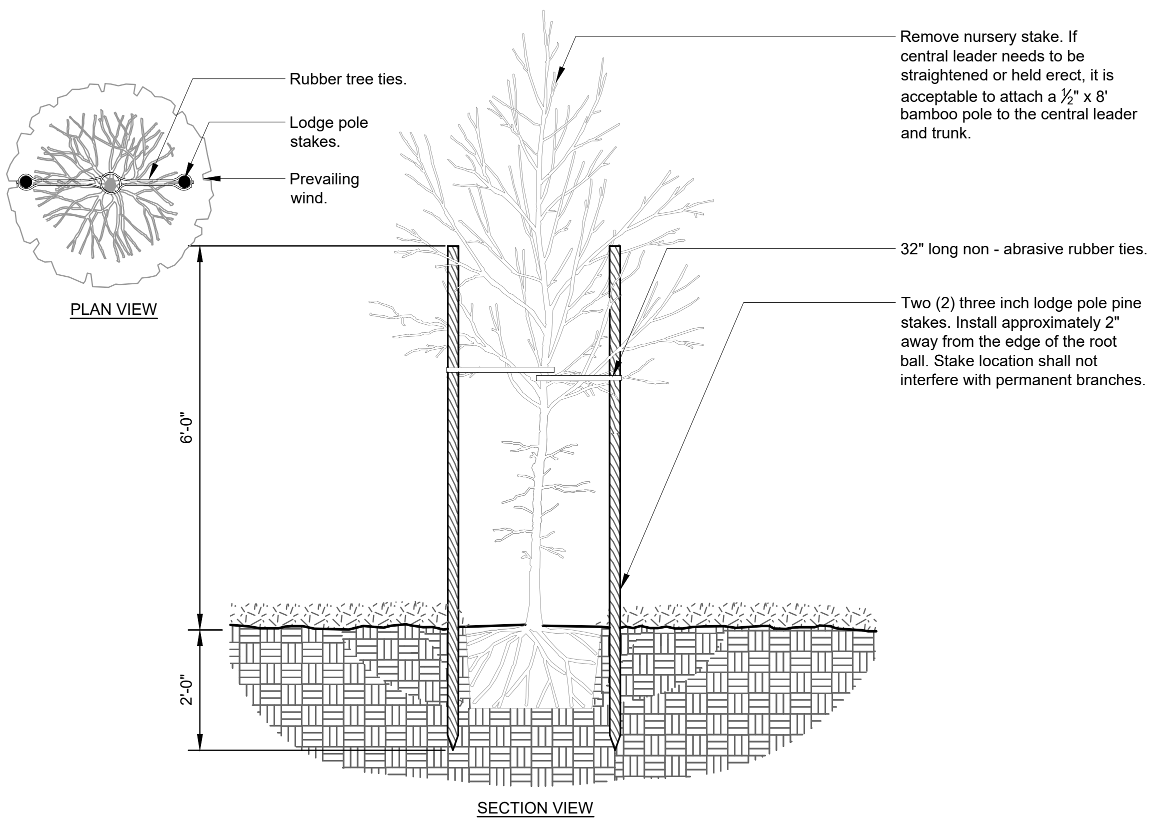
    - Plants shall stand plumb after staking or guying.

    - Stakes shall be driven to sufficient depth to hold the tree rigid.

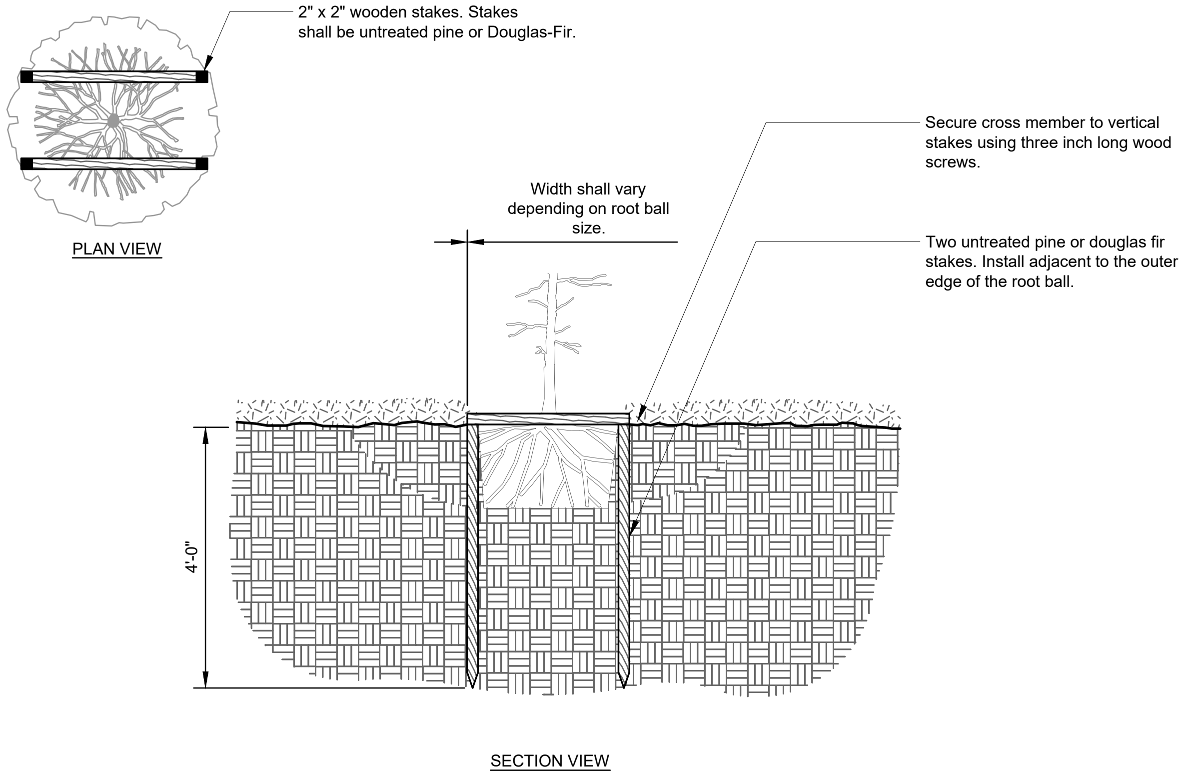
- For trees planted in planting mix over waterproofed membrane, use dead men buried 24 inches to the top of the dead man, in the soil. Tie the guy to the dead man with a double wrap of line around the dead man followed by a double half hitch. When guys are removed, leave the dead men in place and cut the guy tape 12 inches above the ground, leaving the tape end covered in mulch.



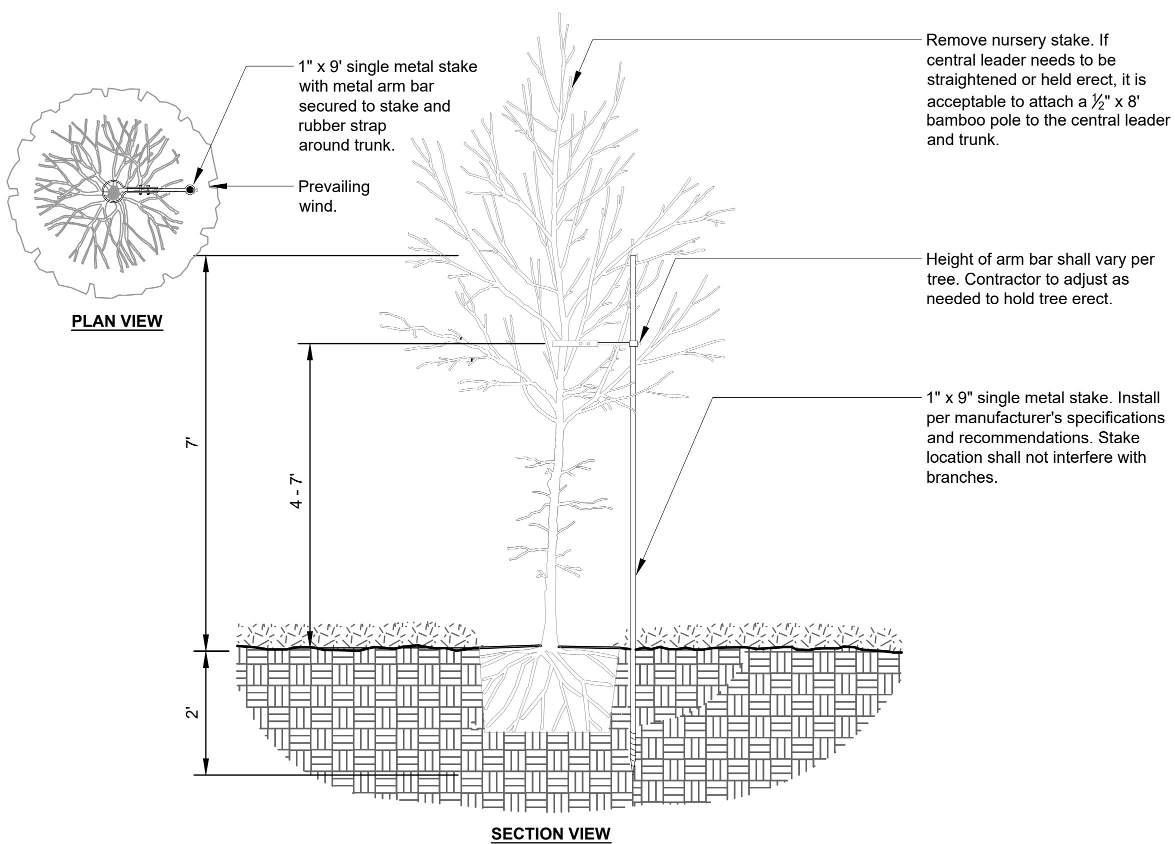
P-X TREE STAKING - LODGE POLES (3)



P-X TREE STAKING - LODGE POLES (2)



P-X TREE STAKING - STAPLE



P-X TREE STAKING - SINGLE METAL STAKE

MULCH

- Apply 2-inches of organic mulch before settlement, covering the entire planting bed area. Feather mulch to zero inches at root collar, beginning at 4 inches from trucks or stems. In no circumstances should mulch contact exposed portions of trunk flare.
- For trees planted in lawn areas the mulch shall extend to a 5 foot radius around the tree or to the extent indicated on the plans.
- Lift all leaves, low hanging stems and other green portions of small plants out of the mulch if covered.
- Mulch shall be "Walk on" grade, coarse, ground, from tree and woody brush sources. The size range shall be a minimum (less than 25% or less of volume) fine particles 3/8 inch or less in size, and a maximum size of individual pieces (largest 20% or less of volume) shall be approximately 1 to 1-1/2 inch in diameter and maximum length approximately 4 to 8". Pieces larger than 8 inch long that are visible on the surface of the mulch after installation shall be removed.
    - It is understood that mulch quality will vary significantly from supplier to supplier and region to region. The above requirements may be modified to conform to the source material from locally reliable suppliers as approved by the Owner's Representative.
- Submit supplier's product specification data sheet and a one gallon sample for approval.
- Apply mulch within 2 days after planting and maintain at specified depth during maintenance period. Maintain mulch at uniform thickness. Do not allow mulch to wash and cover branches and foliage plants. Water thoroughly immediately after mulching and hose down planting area with fine spray to wash leave of plants. Remove any mulch spilled on pavements.

COMPOSTED MULCH

- Composted mulch shall be a well decomposed, humus-like material derived from the decomposition of organic matter. The compost shall have an earthy odor, shall be free of viable weed seeds and other plant propagules (weed seed test sample to be taken from 2" to 8" below surface of the pile), shall have a moisture content such that there is no visible free water or dust produced when handling the material, and shall be free of contaminants. In addition, compost shall have the following physical characteristics:
    - Shall have minimal weed seed or weed propagules present based on germination testing of a representative sample.
    - Shall have less than 100 plant parasitic nematodes per 100 CC of organic matter
    - Shall be free of soil borne pathogens.

- Shall have a pH from 6.5 to 7.0
- Shall have a maximum carbon to nitrogen ration of 20:1 to 40:1 for native plantings.
- Shall have heavy metal concentrations below the WSDA per year load limit
- Shall be certified by the Process to Further Reduce Pathogens guideline for hot composting as established by the United States Environmental Protection agency.
- Shall be produced at a permitted solid waste composting facility

WATERING

- The Contractor is fully responsible to ensure that adequate water is provided to all plants from the point of installation until the date of Substantial Completion Acceptance. The Contractor shall adjust the automatic irrigation system, if available, and apply additional or adjust for less water using hoses as required.
- Hand water root balls of all plants to assure that the root balls have moisture above wilt point and below field capacity. Test the moisture content in each root ball and the soil outside the root ball to determine the water content.
- The Contractor shall install 25 gallon watering bag for each tree to be maintained and used for tree watering during the warranty period.

WATERING BAGS

- Plastic tree watering bags holding a minimum of 15 gallons of water and with a slow drip hole(s) water release system, specifically designed to water establishing trees. Water should release over a several day period, not within a few hours
- Watering bags shall be:
    - Treegator Irrigation Bags sized to the appropriate model for the requirements of the plant, manufactured by Spectrum Products, Inc., Youngsville, NC 27596.
    - Ooze Tube sized to the appropriate model for the requirements of the plant, manufactured by Engineered Water Solutions, Atlanta, GA.
    - Or approved equal.

TREE PRUNING

- After substantial completion, the University Arborist performs preventative maintenance pruning based on the Pacific Northwest Chapter - ISA ANSI A300 Tree Care Standards.

- Prune plants as directed by the University Landscape Architect or University Arborist. Pruning trees shall be limited to addressing structural defects as shown in details; follow recommendations in “Structural Pruning: A Guide For The Green Industry” published by Urban Tree Foundation, Visalia CA.

- All pruning shall be performed by a person experienced in structural tree pruning.

- Except for plants specified as multi-stemmed or as otherwise instructed by the University Landscape Architect, preserve or create a central leader.

- Pruning of large trees shall be done using pole pruners or if needed, from a ladder or hydraulic lift to gain access to the top of the tree. Do not climb in newly planted trees. Small trees can be structurally pruned by laying them over before planting. Pruning may also be performed at the nursery prior to shipping.

- Remove and replace excessively pruned or malformed stock resulting from improper pruning that occurred in the nursery or after.

- Pruning shall be done with clean, sharp tools. No tree paint or sealants shall be used.

- Remove only dead, dying, or broken branches. Do not prune for shape.

- Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION

- During the project work period and prior to Substantial Completion Acceptance, the Contractor shall maintain all plants.

- Maintenance during the period prior to Substantial Completion Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of damaging insects and disease, and in healthy condition. The threshold for applying insecticides and herbicide shall follow established Integrated Pest Management (IPM) procedures. Mulch areas shall be kept reasonably free of weeds, grass.

CLEAN-UP AND DISPOSAL

- During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.
  - Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.
- Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site. The University Landscape Architect seals are to remain on the trees and removed at the end of the warranty period.
- Make all repairs to grades, ruts, and damage by the plant installer to the work or other work at the site.
- Removal and disposal of all excess planting soil, subsoil, mulch, plants, packaging, and other material brought to the site is the responsibility of the Contractor.

SUBSTANTIAL COMPLETION

- Acceptance of the work prior to the start of the warranty period is defined as:
  - Once the Contractor completes the installation of all items in this section, the University Landscape Architect will observe all work for Substantial Completion Acceptance upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of the observation.
  - Substantial Completion Acceptance by the University Landscape Architect shall be for general conformance to specified size, character and quality and not relieve the Contractor of responsibility for full conformance to the contract documents, including correct species.
  - Any plants that are deemed defective as defined under the provisions below shall not be accepted.
- The University Landscape Architect will provide the Contractor with written acknowledgment of the date of Substantial Completion Acceptance and the beginning of the warranty period and plant maintenance period (if plant maintenance is included).

MAINTENANCE DURING WARRANTY PERIOD

- After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner's maintenance and become aware of problems with the maintenance in time to request changes, until the date of End of Warranty Final Acceptance.

    - Notify the University Landscape Architect in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notification must be made in a timely period so that the University Landscape Architect may take corrective action.

        - Notification must define the maintenance needs and describe any corrective action required.

    - In the event that the Contractor fails to visit the site and or notify, in writing, the University Landscape Architect of maintenance needs, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

END OF WARRANTY FINAL ACCEPTANCE

- At the end of the Warranty and Maintenance period the University Landscape Architect shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.

    - If the work is satisfactory, the maintenance period will end on the date of the final observation.

    - If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the University of Washington until the work has been completed, observed, and approved by the University Landscape Architect

- If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the University of Washington for additional observations will be charged to the Contractor at the prevailing hourly rate of the University Landscape Architect.

List of Resources

The following resources were used in the creation of this document.

Antoine, J. (2015). Case Study: Stormwater Funding for Urban Forestry in Vancouver, WA. City of Vancouver Public Works. Retrieved from www.cityofvancouver.us/urbanforestry

Aspinall, P., Mavros, P., Coyne, R., & Roe, J. (n.d.). The urban brain: analysing outdoor physical activity with mobile EEG. http://doi.org/10.1136/bjsports-2012-091877

Dillard, C. (2015). Making the Urban Forest Matter: Persuasive Tools and Techniques. Seattle.

Dilley, J. (2015). The Role of Trees in Seattle's Stormwater Management. Seattle.

Donovan, G. H., & Butry, D. T. (2009). The value of shade: Estimating the effect of urban trees on summertime electricity use. Energy and Buildings. http://doi.org/10.1016/j.enbuild.2009.01.002

Donovan, G. H., Butry, D. T., Michael, Y. L., Prestemon, J. P., Liebhold, A. M., Gatziolis, D., & Mao, M. Y. (2013). The relationship between trees and human health: Evidence from the spread of the emerald ash borer. American Journal of Preventive Medicine. http://doi.org/10.1016/j.amepre.2012.09.066

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Gibbons, K. H., Ryan, C., Bradley, G., & Perez, M. (2014). A Framework for Developing and Evaluating Comprehensive Urban Forest Management Plans: An Analysis of Washington State Plans. University of Washington.

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Nowak, D. J., Stein, S. M., Randler, P. B., Greenfi eld, E. J., Comas, S. J., Carr, M. A., ... eld, G. (2010). Sustaining America's Sustaining America's Urban Trees and Forests Urban Trees and Forests A Forests on the Edge Report ABSTRACT.

State University Extension, O. (2009). Tree Protection on Construction and Development Sites A Best Management Practices Guidebook for the Pacific Northwest, 1–18.

Wolf, K. (2015). Co-Benefits of the Urban Forest with a mental health focus. Seattle: University of Washington.

Wyse, S. V., Beggs, J. R., Burns, B. R., & Stanley, M. C. (2015). Protecting trees at an individual level provides insufficient safeguard for urban forests. Landscape and Urban Planning. http://doi.org/10.1016/j.landurbplan.2015.05.006

Yadrick, M. (2015). City of Seattle Parks and Recreation Subject: Alder and Maple Thinning in the Forested Parklands. Seattle Parks and Recreation, (206), 615–1046.

ADDITIONAL RESOURCES

UW Urban Forest Symposium May 20, 2015

UW Urban Forest Committee

University Landscape Advisory Committee

UW Precision Forestry Group

Patrick Pirtle

Sara Shores

Kristine Kenney

Sarah Reichard

Google Maps

UW Visual Asset Collection

APPENDIX C

Stormwater System Maps and Potential Stormwater Strategies

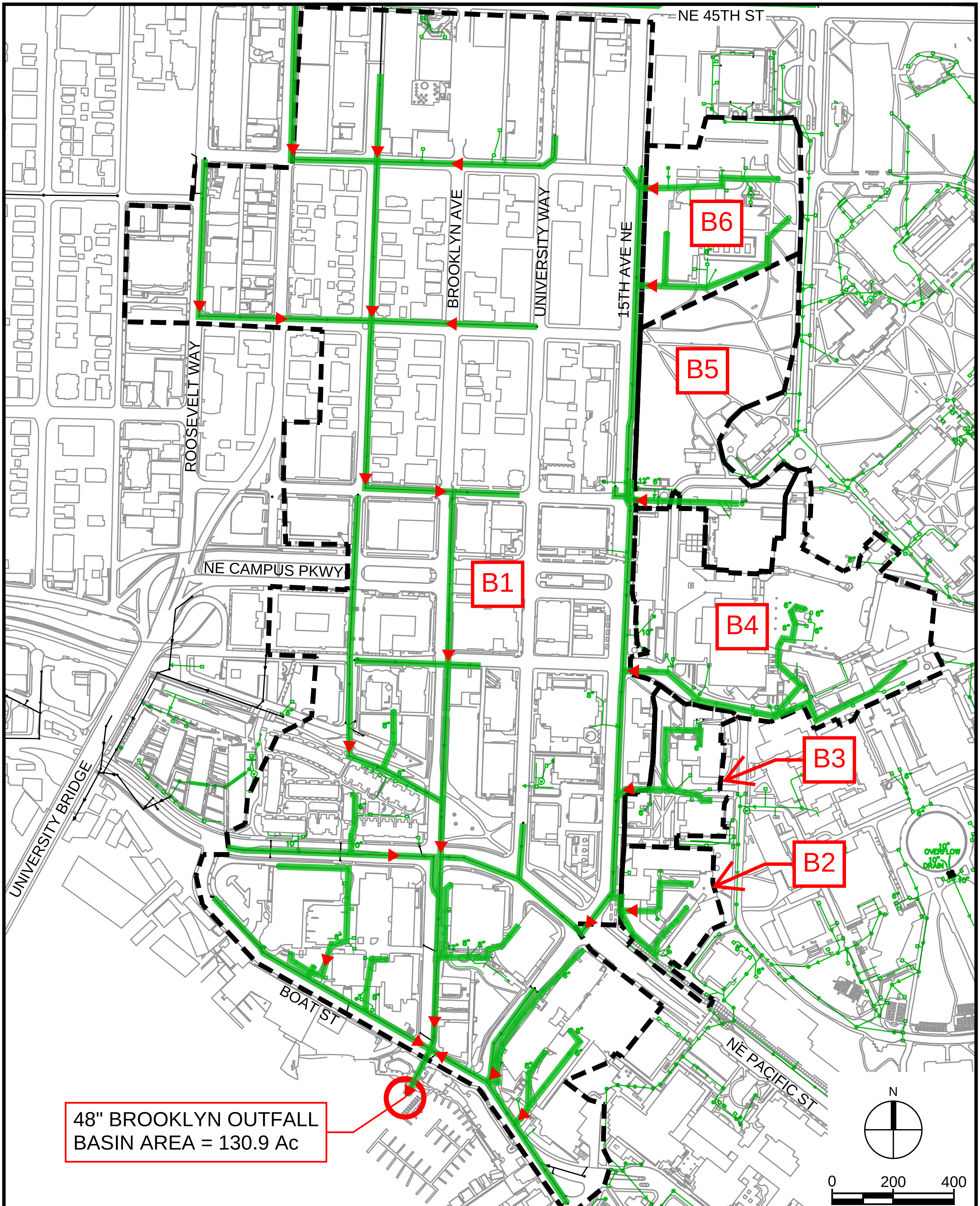

FIGURE 3.14-B1
BROOKLYN OUTFALL - EXISTING STORM SYSTEM

kpff

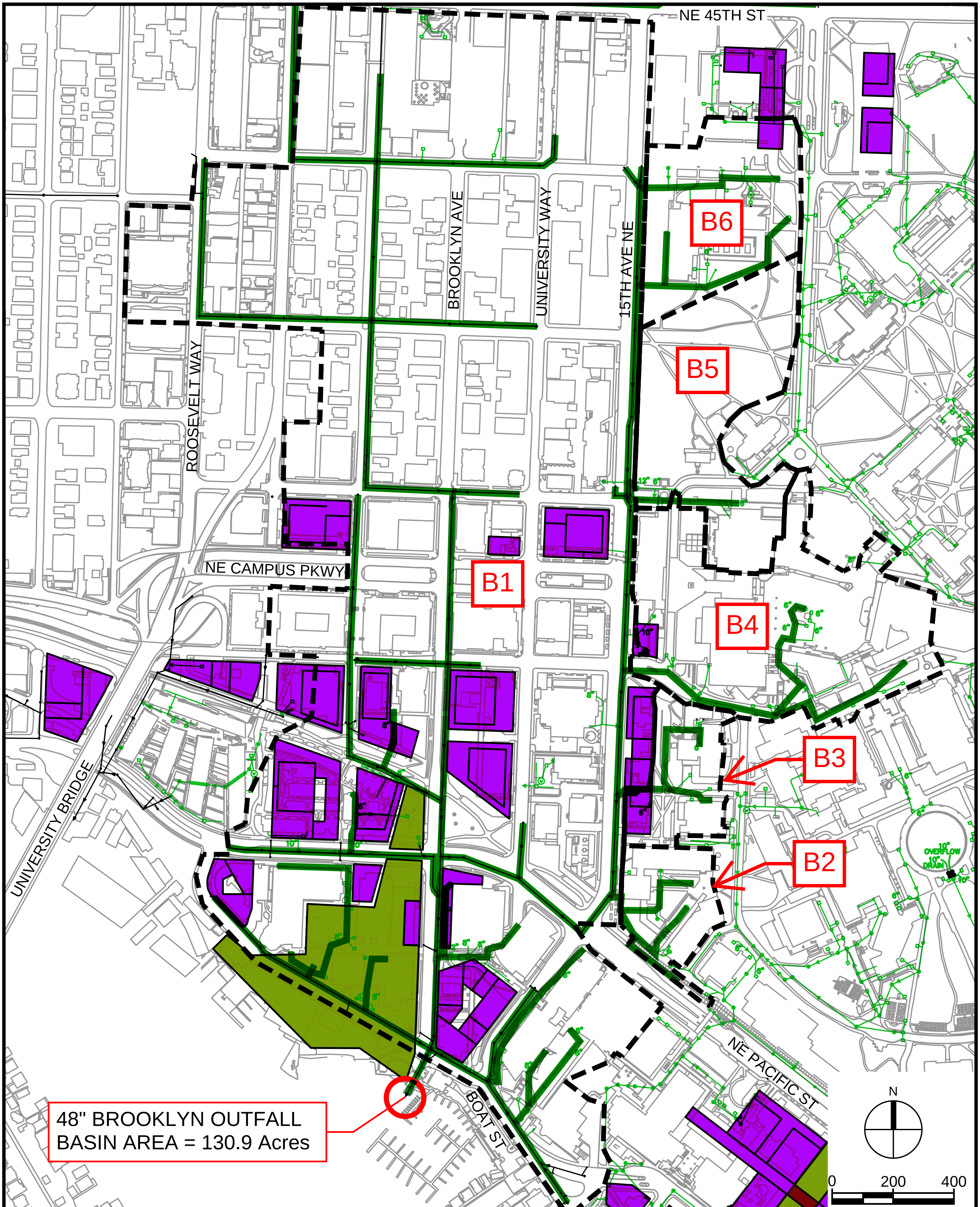

FIGURE 3.14-B2
BROOKLYN OUTFALL WITH ALTERNATE 1 DEVELOPMENT

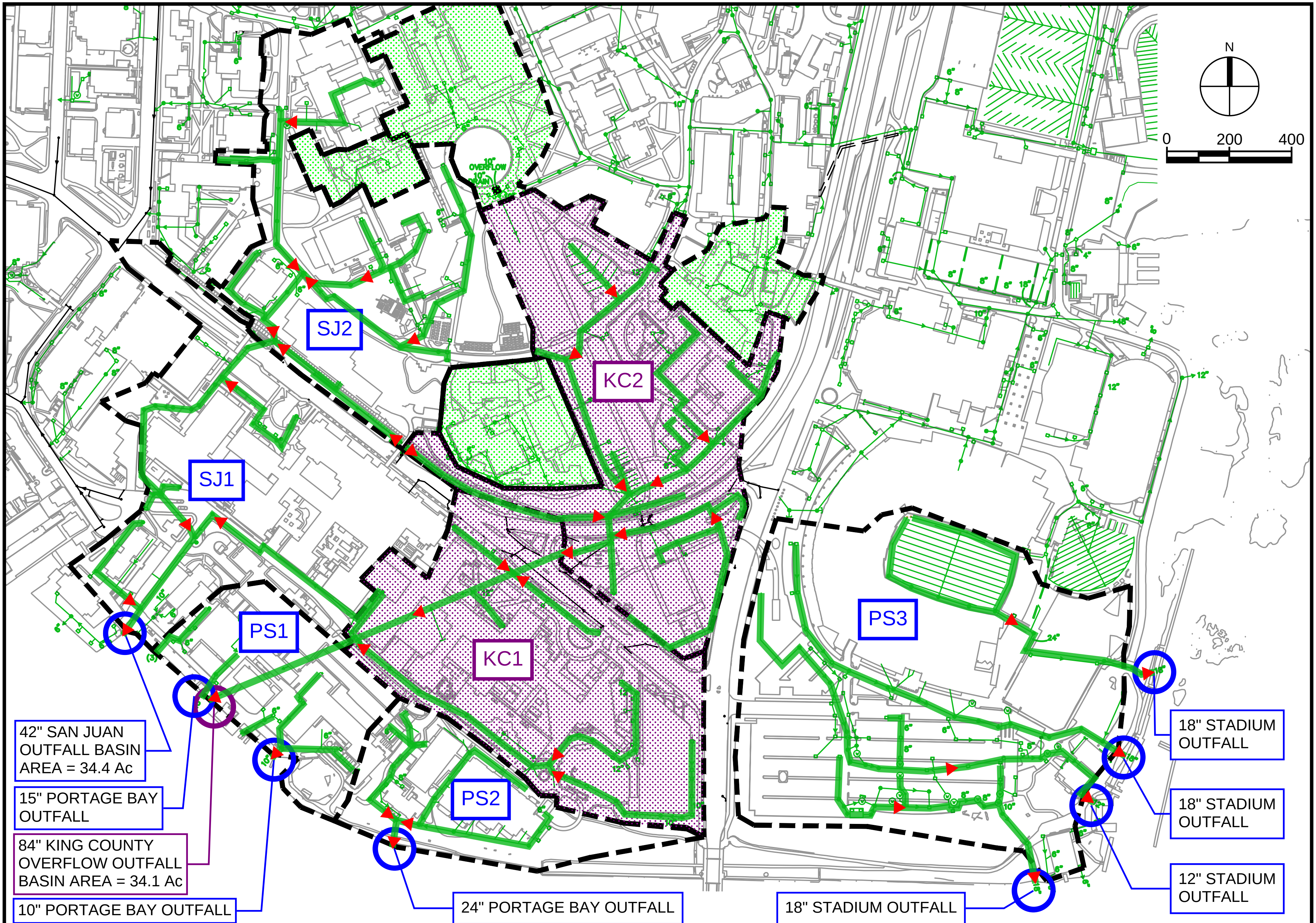

FIGURE 3.14-C1
PORTAGE BAY AND STADIUM OUTFALLS - EXISTING STORM SYSTEM

kpff

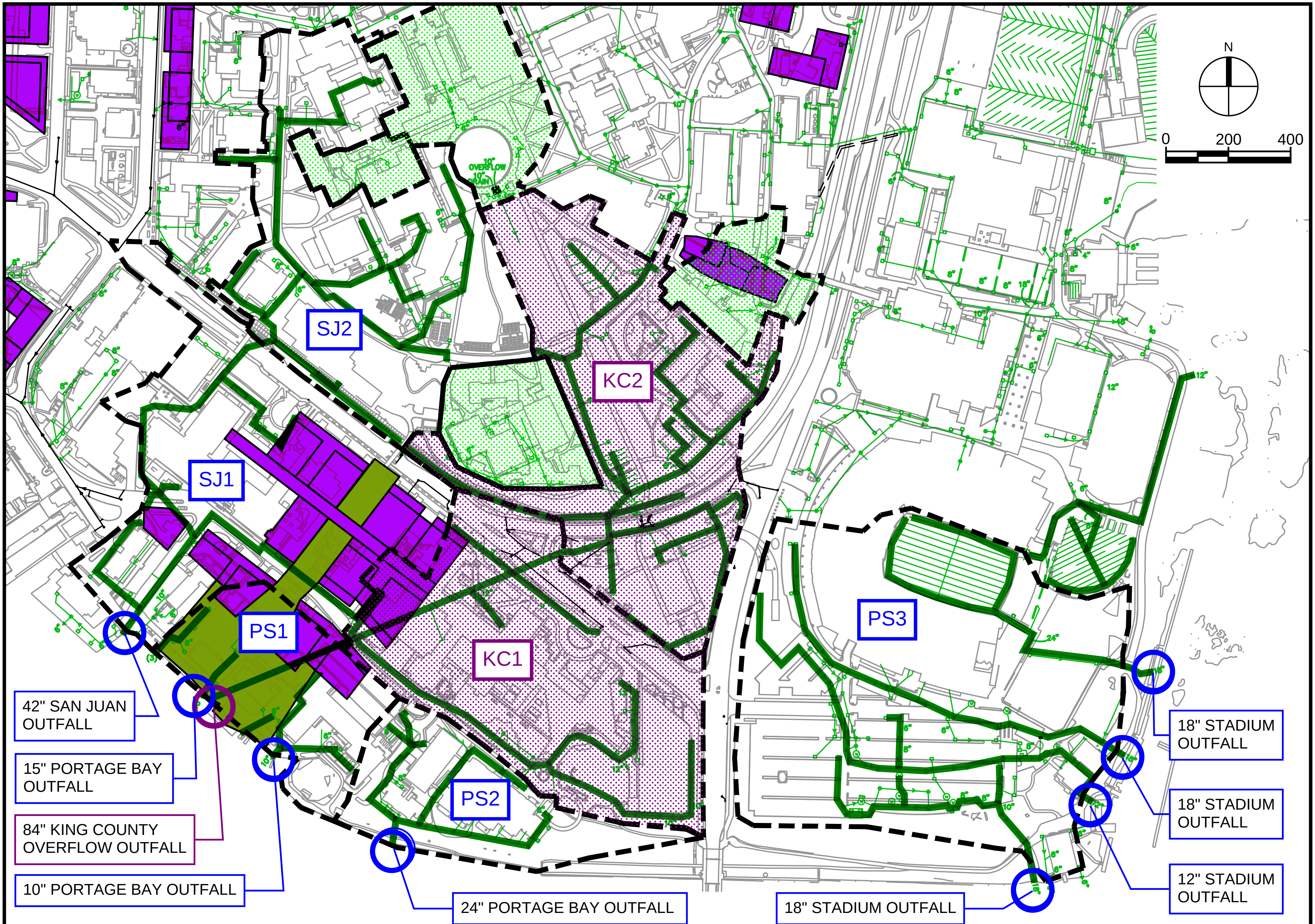

FIGURE 3.14-C2
PORTAGE BAY AND STADIUM OUTFALLS - ALTERNATE 1 DEVELOPMENT

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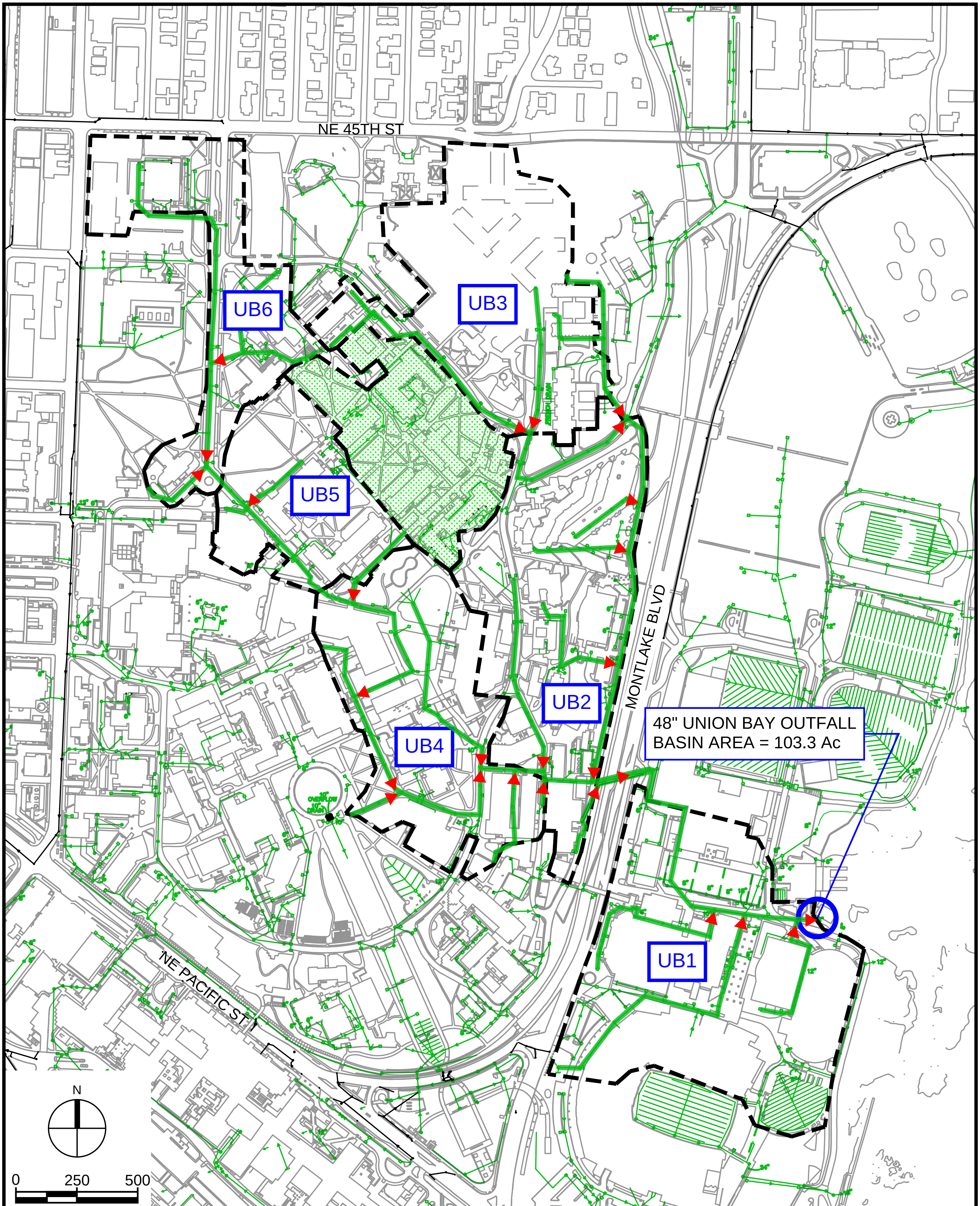

FIGURE 3.14-D1
UNION BAY OUTFALL - EXISTING STORM SYSTEM

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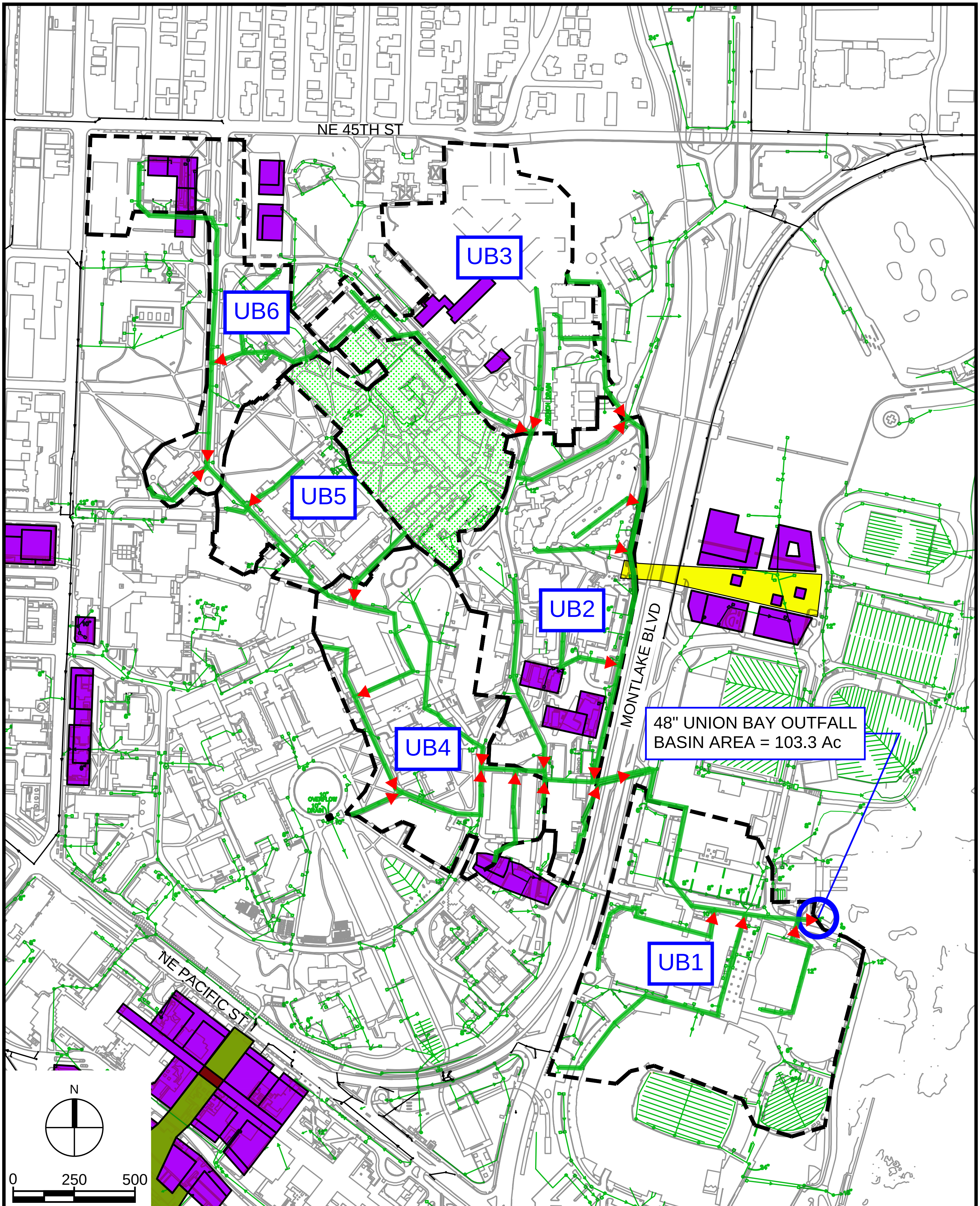

FIGURE 3.14-D2
UNION BAY OUTFALL - ALTERNATE 1 DEVELOPMENT

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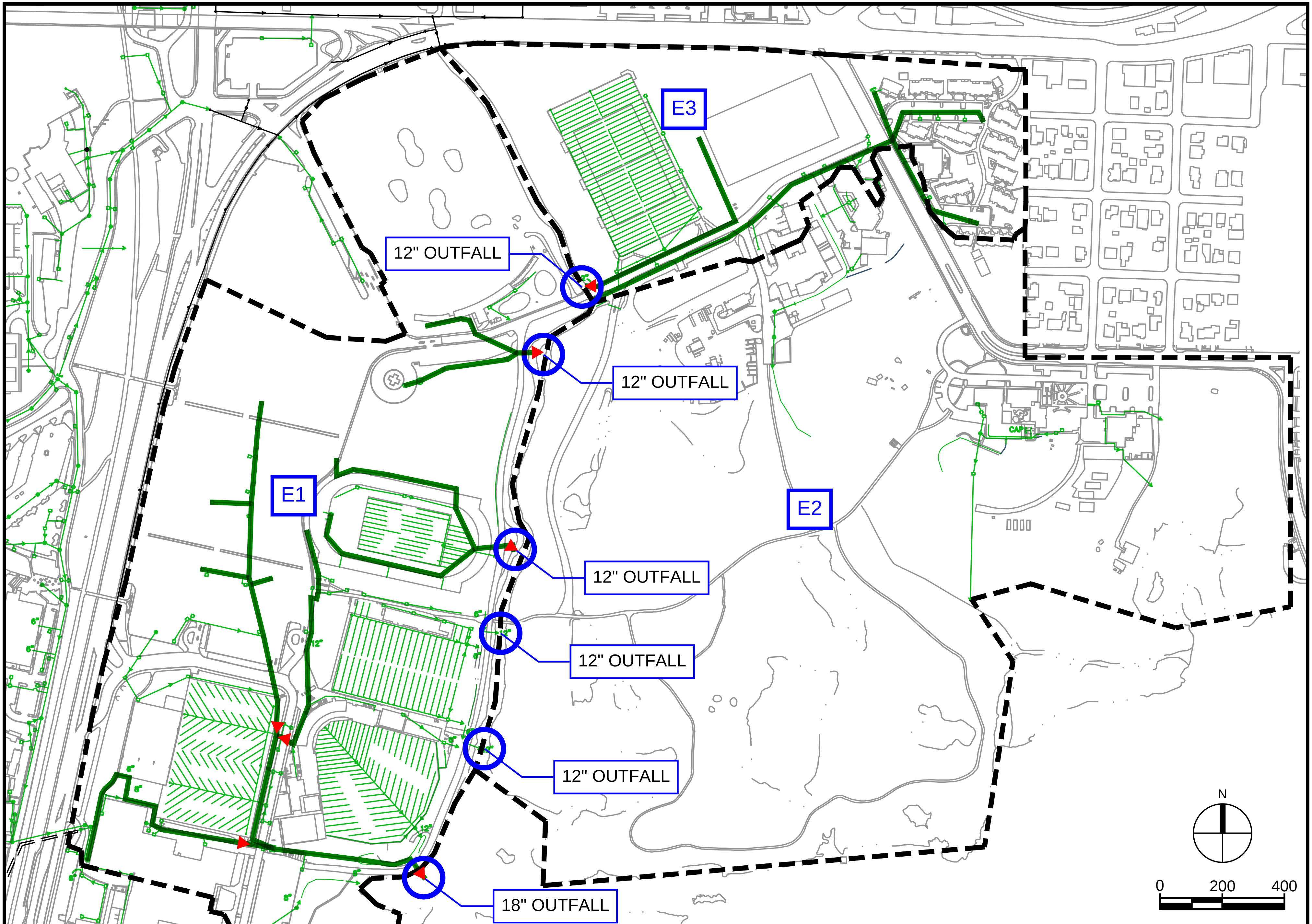

FIGURE 3.14-E1
EAST CAMPUS OUTFALLS - EXISTING STORM SYSTEM

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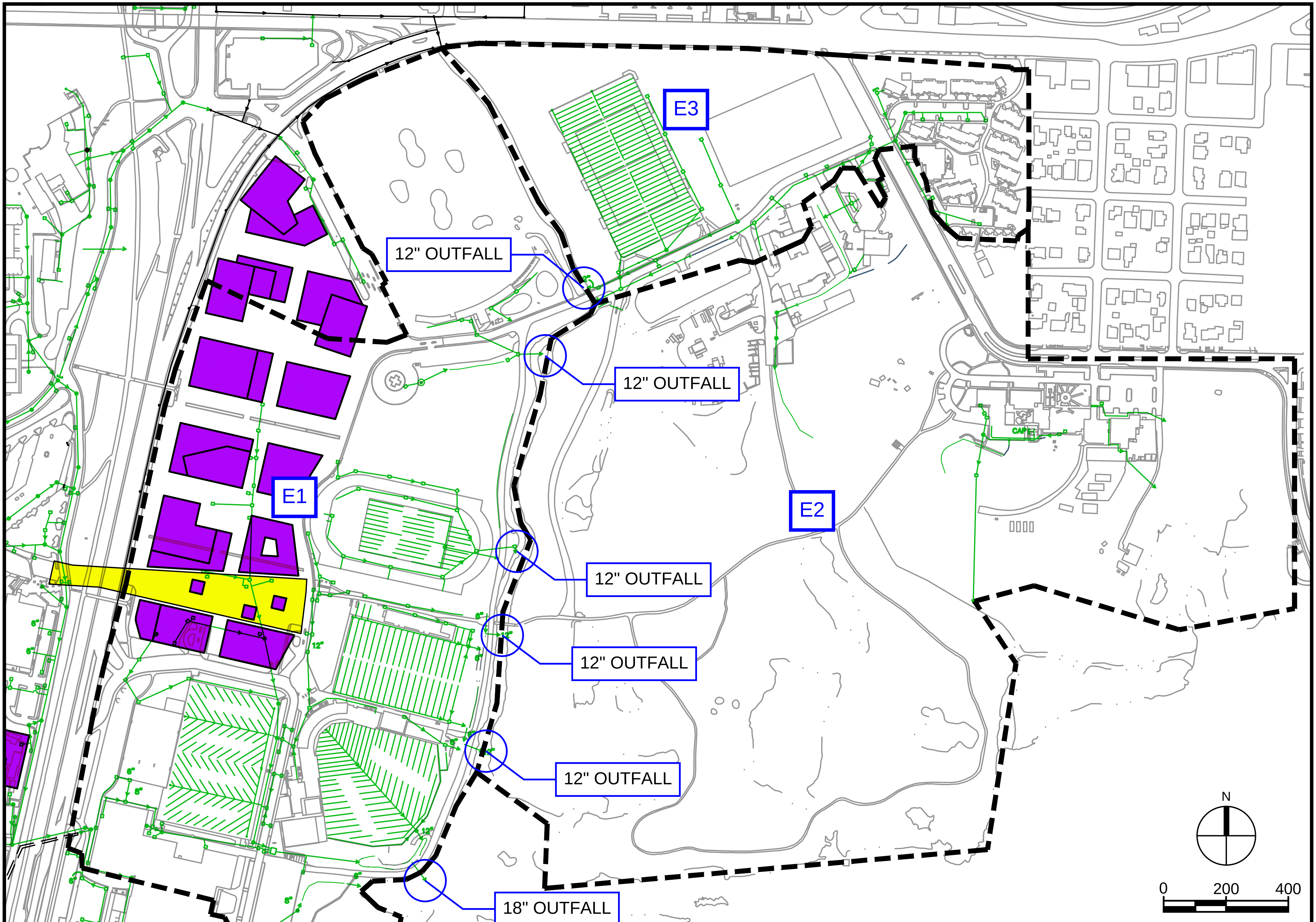


FIGURE 3.14-E2
EAST CAMPUS OUTFALLS - ALTERNATE 2 DEVELOPMENT

Water Quality Strategy

According to Section 5.4.2.4 of the Seattle Stormwater Manual, stormwater collected from pollutant generating surfaces that drain to Lake Union and Lake Washington require *Basic Treatment. Basic Treatment* requires a drainage control facility designed to reduce concentrations of total suspended solids in drainage water. All new UW projects with greater than 5,000 SF of new or replaced pollutant generating hard surfaces (PGHS) or ¾ acres of new pollutant generating pervious surfaces (PHPS) require basic water quality treatment. Water quality treatment is not required for stormwater runoff to combined sewers.

Water quality facilities can be implemented on a project-by-project basis or given the flexibility of the campus and the control of property UW has near the storm outfalls to Portage Bay and Union Bay, basin-sized regional water quality systems for certain stormwater outfalls is feasible.

Project-by Project Systems

Project-by-project water quality systems allowed per the Seattle Stormwater Manual that work within the UW program include:

- **Proprietary Filter Media Cartridge** systems in vaults, manholes or catch basins. These systems are space efficient and easy to maintain but have become expensive compared to other Best Management Practices (BMP) due to the 2016 Stormwater Manual requirement to increase the water quality design flow rate beyond the manufacturer's design parameters. Also, the Stormwater Manual does not allow these systems to be used as credit for Onsite Stormwater Management (OSSM).

Example of Proprietary Filter Media Cartridge System

- **Permeable Pavement Surfaces** treat PGHS through the base pavement layers and underlying subbase soil. This BMP has the advantage of treating unconcentrated rainfall as it falls, so the water quality facility is the pavement section. This BMP does not require well infiltrating soils since the runoff is unconcentrated. Underlying soils do need to have the proper cation exchange capacity and organic content for water quality treatment. If the soil does not meet these criteria, then imported sand/soil mix can be placed instead.

Porous pavement materials need to be chosen carefully to fit within the context of the campus environment aesthetics as well as potential for utility trenching post pavement placement. Porous asphalt, in particular, does not lend to successful pavement patching. Porous concrete would need to be replaced in panels rather than trench cut repair. Porous pavers, however, can be removed and replaced by hand for utility trenching.

Porous pavement surfaces are a space saving and economical water quality BMP and also double as an OSSM BMP.

Example Porous Concrete

- **Non-Infiltrating Bioretention** is typically used on campus for OSSM but can also be used as basic water quality treatment and would be an appropriate BMP for campus applications. This BMP is discussed in more detail in the Onsite Stormwater Management Strategy section.

Example Large Bioretention Facility,, Seattle, WA

Example of Small Bioretention Facility, Edmonds, WA

- **Biofiltration Swales** use vegetation in conjunction with slow and shallow-depth flow for runoff treatment and would be appropriate along the waterfront edges of campus that can accommodate the minimum footprint of 20 feet by 100 feet. If Biofiltration swales are used, the grasses chosen should be native and not mowed to fit with the campus aesthetics and improved water retention. This BMP cannot be used for OSSM credit, however.

Example of Parking Lot Biofiltration Swale with Tall Grasses

There are other project-by-project water quality BMP's available in the Stormwater Manual but are not mentioned here because they do not optimize cost, space and maintenance needs required by UW nor are they appropriate to the marginal infiltrative soils on campus.

Regional Systems

Regional water quality systems would be strategically located at or near the outfall of a drainage basin. Four locations were chosen that both optimize the untreated areas of the campus with respect to future development as well as areas that can seamlessly site the facility into the campus context, see **Figure 3.14-F.**

Approved regional water quality systems for basic treatment allowed by the Stormwater Manual include biofiltration swales, non-infiltrating bioretention and stormwater treatment wetlands. For practical purposes regarding space constraints and the urban campus context of the University of Washington, the preferred regional system is a flow-through biofiltration swale facility that has been implemented by Seattle Public Utilities in the Cascade Neighborhood known as the Capital Hill Water Quality Project or *Swale on Yale*, see Figure 3.14X for data and images of the *Swale on Yale* and the website:

http://www.seattle.gov/util/EnvironmentConservation/Projects/SwaleonYale/index.htm

Photo of Swale on Yale

The Swale on Yale system was not sized to the *water quality storm volume* or *flow rate on an average annual basis* per the Seattle Stormwater Manual due to space constraints. The system was instead sized based on a modeling approach for larger basins with *Basic Treatment* performance criteria of removing 80 percent of the total suspended solids (TSS). This flow-through biofiltration swale is enhanced with biofiltration soils and a perforated underdrain.

The Swale on Yale is currently monitored for removal of total suspended solids, metals and nutrients. The monitoring data indicate that this facility not only exceeds the requirements for basic treatment but also for enhanced treatment and partial goal requirements for phosphorous treatment as summarized below:

Total Suspended Solids Reduction	85%
Total Copper Reduction	80%
Total Phosphorus Reduction	25%
Flow Reduction	20%

Note the 20 percent flow control reduction allows this facility to also be considered as a regional OSSM facility.

The proposed facility can be very urban in context like the Swale on Yale or softened to look more natural. The key is to have cells that spread the stormwater runoff evenly and allow a minimum residence time of 9-minutes through the plant/soil system. A below grade diversion structure upstream of the swale is required to divert the lower flow first flush storm flows to the facility, which contain the bulk of the pollutants. Higher flows, therefore, bypass the swale via a diversion structure. In addition, a swirl concentrator vault upstream of the swale removes trash and larger sediments.

The Swale on Yale surface area of 14,500 SF treats a basin of 435-acres or approximately 30 SF/acre ratio of swale per treated basin.

Maintenance requires replacement of approximately 10 percent of the plants per year and sediment/debris removal on a regular basis depending on sediment loads from the basin.

A summary of the proposed regional locations are shown on **Figure 3.14-F** and described as follows:

- **Brooklyn Outfall**: This regional system will result in the biggest impact of the four proposed regional systems for the follow reasons:
    - Contains the largest basin of approximately 131 acres, more than half is property not owned by the UW.
    - The majority of the basin is currently untreated with the largest percentage of PGHS of any of the other campus basins given the amount of area occupied by city streets and parking lots.
    - The West Campus will have a significant future development footprint.
    - The sloping Brooklyn Avenue is ideal for this urban swale for both the urban context and hydraulics of the existing pubic storm drain. The swale can also be incorporated into the future West Campus Green. The footprint of the swale would be approximately 15-feet by 265-feet or narrower and longer. The cell nature of the swale allows it to be separated into parts to fit the area. For instance, it can occupy one side of the street or both or in parts of the street and park. The cells would need to be separated vertically (ie, cascading) on Brooklyn because the slope of the street exceeds the maximum design slope of the swale.
- **San Juan Outfall:** This regional system would treat a 34-acre basin containing equal portions of the South Campus and Central Campus. This area is also largely untreated in its current state. There is a convenient location for this swale on the west side of San Juan Road adjacent to the Ocean Teaching Building. The runoff from the existing metal roof of this building could be diverted to the swale providing additional benefit. The swale footprint would be approximately 10-feet by 105-feet.

- **Union Bay Outfall:** This regional system would capture a significant portion of the Central Campus and a portion of the East Campus, in all approximately 103-acres. Locating the swale in this area would be more challenging given the lack of space and shallow hydraulics of the existing storm system. The 15-foot by 150-foot swale footprint could be separated into various areas, most likely in the existing planter between the tennis courts and Snohomish Lane and the planters adjacent to Walla Walla Road and the Nordstrom Tennis Center.

- **East Campus Outfall:** This regional system would focus on capturing the stormwater runoff for the area occupied by the existing E1 Parking Lot. This swale footprint would be 10-feet by 150-feet and conveniently fit along an existing grass area between the tennis courts and Wahkiakum Road.

Regional versus Project Based Systems

Below is a brief analysis comparing the pros and cons of water quality facilities on a project-by-project basis versus regional basin systems:

- **Costs:** Regional systems would have a higher capital first cost than project-by-project systems simply because they are larger and more complex. Project based systems spreads the cost of treatment over the master plan build-out timeframe. However, once installed, regional systems remove the water quality cost burden on individual projects. A factor to consider is that stormwater treatment first costs for projects continue to increase as regulations change. Having a regional system would buffer UW from these unknown cost increases. For instance, future drainage codes may consider all roofs, regardless of the material as pollutant generating.

- **Maintenance:** In aggregate, regional systems would have a smaller maintenance burden than project systems simply because the maintenance is concentrated at fewer facilities. This statement is somewhat mitigated by the fact that OSSM facilities such as non-infiltrating bioretention planters can also serve as water quality facilities.

- **Space Requirements:** In aggregate, regional systems should require less space than project based systems due to their economy of scale efficiency. Again, this statement is somewhat mitigated by the fact that OSSM facilities such as non-infiltrating bioretention planters can also serve as water quality facilities. Project based systems generally fit seamlessly into project site landscaping. There are projects, however, that may have larger PGHS and PGPS such as access roads, parking lots and large landscape areas that require a significant site area contribution or high costs for below grade canister treatment systems. As individual facilities, regional systems require a larger space commitment that requires good planning and design to use space allocated efficiently.

- **Aesthetics:** Both regional and project based water quality systems have the potential to contribute greatly to the aesthetics of the campus. Depending on the application, project based systems would be more subtle given their smaller footprint while the regional systems would create an impact given their larger footprint. Appropriately designed and sited, these facilities would add to the quality and function of area rather than just take up space.

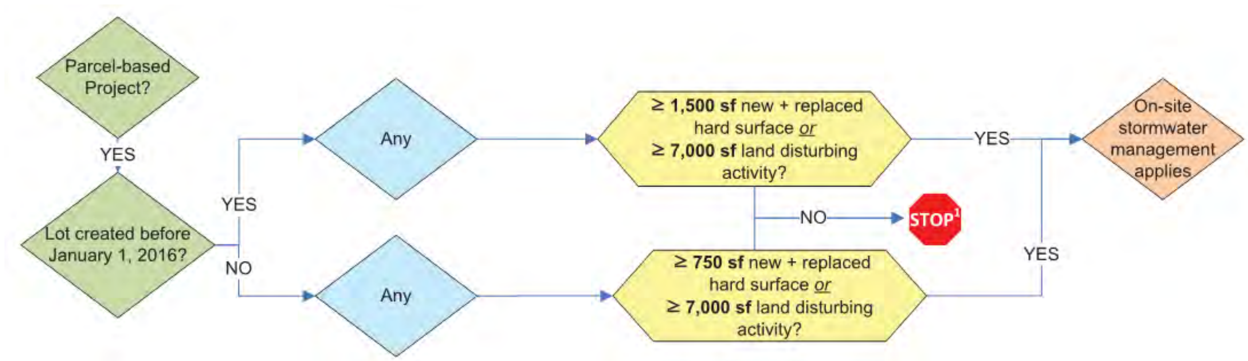
- **Other Considerations:**
  - OSSM facilities such as non-infiltrating bioretention planters and filter strips combined with dispersion can also serve as water quality facilities for project based applications. Not all sites, however, can accommodate these facilities requiring other more costly methods.
  - Project based systems typically only treat specific pollutant generating surfaces on site to keep the facility as economical as possible for both cost and space considerations. Regional systems, however, must treat the entire basin area it serves; therefore, capturing untreated runoff from area developed before water quality code requirements. Thus, regional systems, while not required by UW to implement, would demonstrate significant environmental stewardship.
  - Regional systems mitigate all stormwater quality demands in a particular basin area so that future projects within that basin are not burdened by providing water quality. This strategy is referred to as “banking”.
  - Regional systems could be designed, permitted and constructed as part of a building project or as a stand-alone infrastructure project. For instance, a regional system on Brooklyn Avenue NE and Boat Street could be part of the future King County CSO University Storage Tank/West Campus Green project.
  - The burden to perform is greater for regional systems than project based systems because the basin is relying on a single facility.
  - Regional systems make it economically possible to install monitoring equipment to test the quality of the stormwater prior to entering the bay.

On-Site Stormwater Management

The purpose of this section is to outline the City of Seattle Stormwater Code requirement for On-Site Stormwater Management and to recommend how best to address that requirement within the UW Campus development framework.

Evaluation

On-Site Stormwater Management (OSSM) is a requirement first introduced in the 2016 City of Seattle Stormwater Code and must be evaluated *in addition to* the evaluation of Flow Control and Water Quality treatment requirements. The flow chart below illustrates the path to determining whether OSSM needs to be evaluated for a Parcel-Based Project, which is the appropriate project classification for a typical UW building development.



The main UW campus fits within a single parcel which was created prior to January 1, 2016 and therefore this flow chart applies. For more information on this flow chart refer to Figure 4.2A in Volume 1 of the 2016 City of Seattle Stormwater Manual.

Intent

The intent of OSSM is to reduce runoff by using infiltration, evapotranspiration and/or stormwater reuse. OSSM can be evaluated either:

- On a performance-based approach where calculable stormwater discharge durations are compared (post-developed vs. pre-developed pasture conditions), or;
- On a list-based approach where predetermined and categorized BMPs are strategically incorporated into the design of a development to address all surfaces introduced by said development.

Typically the performance-based approach would be selected for sites where infiltration rates are extremely high, or for projects that plan to maximize Rainwater Harvesting efforts. Since these do not apply to a typical UW campus redevelopment project, we recommend the list-based approach be used.

Recommended Implementation

Table Y.YY below summarizes OSSM BMPs, noting which are recommended as Regional Facility Opportunities and which are recommended for implementation on a project-by-project basis. Subsequent sections discuss each BMP in more detail with respect to recommended implementation.

BMPs which have been classified as "not feasible" are also discussed along with reasons for that classification.

BMPs annotated as "Evaluation Not Required but is Allowed" are classified as such by the 2016 Drainage Code because runoff from the UW campus discharges to a Designated Receiving Water. While evaluation of these BMPs is not required, they are being recommended as ways by which to meet the intent of the code in scenarios where their implementation is appropriate.

As shown in Table Y.YY, BMPs are prioritized by category and must be evaluated based on that prioritization. BMPs in the highest category (Category 1) must be deemed infeasible before BMPs in the next category can be considered. BMPs denoted with an asterisk (*) require an infiltration investigation indicating appropriate infiltration rates are available prior to BMP approval by SDCI.

Category	BMP	Regional Facility Opportunity	Project-by-Project Evaluation	Not Feasible	Evaluation Not Required but is Allowed
1	Full Dispersion			✗	
	Infiltration Trenches*			✗	
	Dry Wells*			✗	
2	Rain Gardens*	✓			
	Infiltrating Bioretention*			✗	
	Rainwater Harvesting	✓			✱
	Permeable Pavement Facilities*	✓			
	Permeable Pavement Surfaces		✓		
3	Sheet Flow Dispersion		✓		
	Concentrated Flow Dispersion			✗	
	Splashblock Downspout Dispersion			✗	
	Trench Downspout Dispersion			✗	
	Non-infiltrating Bioretention	✓	✓		
	Vegetated Roofs		✓		✱
4	Perforated Stub-out Connections*			✗	
	Newly Planted Trees		✓		

Table Y.YY – Recommended Implementation Strategies: On-Site List for Parcel Based Projects

Regional OSSM Facility Opportunities

For varying reasons, installation of OSSM BMPs can be challenging on some project sites, for some types of projects, or for some portions of a project. We recognize that opportunities may exist throughout the UW campus where, through negotiations and formal agreement with Seattle Public Utilities (SPU), regional BMPs can be installed with the intent of pre-assigning credit to the UW for future projects where these challenges present themselves. It is likely that, in order to take advantage of this pre-assigned credit, a project would need to be located within the same drainage basin as the regional OSSM facility.

The intent of installing regional facilities is to meet code requirements in areas of campus where it is easier to do so in order to avoid the challenge of forcing OSSM BMPs into projects where installation is more challenging. In addition, the only facilities requiring infiltration investigation would be regional facilities, removing the burden of infiltration testing from each individual construction project. Two of the three BMPs recommended to be considered as Regional OSSM facilities do require that infiltration investigations be completed, while recommended Project-by-Project BMPs do not.

Rain Gardens (Category 2) / Non-Infiltrating Bioretention (Category 3)

In areas of campus where low spots exist and surrounding surfaces already drain to them, or where curb cuts can easily be installed to redirect roadway runoff, the installation of Rain Gardens can be explored. The surrounding surfaces would remain in their existing condition, and therefore credit for that tributary area could be applied to future projects where OSSM BMPs are not feasible.

Rain Gardens do require that infiltration rates be measured prior to approval and installation. If these tests reveal that adequate infiltration rates are not available, the installation of Non-Infiltrating Bioretention Facilities could be considered as an alternative.

Examples of locations on campus where rain gardens/non-infiltrating bioretention facilities could be installed are:

- The low point in the Sylvan Grove Theatre
- The base of the upper Rainier Vista north of Stevens Way NE
- The low point in the lower Rainier Vista south of Stevens Way NE
- The base of the Portage Bay Vista adjacent to Boat Street
- The open space near the existing storm outfall east of the Salmon Rearing Pond

See Figure 5.14, Volume 3 of the 2016 City of Seattle Stormwater Manual for a typical Rain Garden section.

See Figures 5.24 and 5.25, Volume 3 of the 2016 City of Seattle Stormwater Manual for typical sections of Non-Infiltration Bioretention Facilities.

Rainwater Harvesting (Category 2)

Rainwater Harvesting is listed as “Not Required, but Allowed” with respect to its implementation as an OSSM BMP for areas of the City that drain to a designated receiving water, as the UW Campus does. While it is recognized that Rainwater Harvesting may not be a desirable for building projects on campus, there are areas of campus that lend themselves well to a stormwater collection and re-use system. In those areas Rainwater Harvesting is recommended as a Regional OSSM Facility.

Drumheller Fountain is an example of an existing system that could incorporate rainwater harvesting. The fountain currently sources potable water, and when it is in use a significant amount of that water is lost to evapotranspiration. Drainage from surrounding buildings and plaza surfaces are currently collected and piped to either the campus storm drainage system or the campus combined sewer system. If a cistern was installed these areas could be re-piped to drain to the cistern which could then pump water to the fountain to reduce the amount of potable water used. This would also result in a reduction in the amount of surface water that drains to the combined sewer system, which is another goal the UW has for its campus.

To take full advantage of the Drumheller cistern, it could also be used to capture water released from the fountain when necessary for maintenance. If maintenance is completed at dry times, the cistern would be empty and therefore available to capture/reuse water that would otherwise discharge directly to the combined sewer system.

Permeable Pavement Facilities (Category 2)

Permeable Pavement Facilities (PPFs) are classified differently from Permeable Pavement Surfaces (PPSs); while PPSs are designed to capture only rain water that falls directly on them, PPFs are designed to also capture runoff from surrounding areas. PPFs do require that infiltration rates be measured prior to approval and installation.

To incorporate PPFs as OSSM BMPs, the UW could approach future repaving project on campus under a new light. If infiltration rates are deemed sufficient within the footprint of the repaving project, runoff from surrounding areas could be routed to the newly paved roadway or parking lot, which would then be designed as PPF.

Project-by-Project Evaluation

As it currently stands, each UW project is required to evaluate the entire list of OSSM BMPs (see Table Y.YY) to determine which are feasible and which are not. Through rounds of discussion and negotiations with the City an agreement is made with respect to which BMPs will be installed. Because the campus landscape is such an important part of its overall aesthetic and because OSSM BMPs can significantly impact that aesthetic, this is often a long and time consuming process.

Through the adoption of a Drainage Master Plan the goal is to narrow down the list of OSSM BMPs considered for implementation on campus projects, simplifying the design/permitting process for both the City and the UW. The BMPs listed below are appropriate for consideration on a typical UW building project and are recommended for evaluation on a project-by-project basis.

Permeable Pavement Surfaces (Category 2)

In some cases permeable pavement is an appropriate BMP to address OSSM requirements. Some such instances are:

- Pedestrian pathways.
- Driveways and lanes not used as service access.
- Parking lots (parking stalls, not drive aisles).

There are also areas where permeable pavement surfaces are not recommended, such as:

- Loading docks.
- Bus routes.
- Parking lot drive aisles, or other surfaces where wheels of stationary vehicles will be turning.
- Shady, treed areas (See Sheet Flow Dispersion).

See Storm Water Quality Strategy section for additional information on permeable pavement surfaces.

Porous Paver System Example, Montlake Triangle

Porous Concrete Example, Montlake Triangle

Sheet Flow Dispersion (Category 3)

While permeable pavement surfaces are in a category up from Sheet Flow Dispersion, in some instances it is not appropriate to install permeable pavement. For example, in shady, treed areas there is a risk of moss growth and tree foliage blocking the pores necessary for permeable pavement to function as designed. In conditions such as this, sheet flow dispersion is an appropriate BMP that can be implemented.

See Figure 5.5, Volume 3 of the 2016 City of Seattle Stormwater Manual for information on typical Sheet Flow Dispersion layout.

Non-Infiltrating Bioretention (Category 3)

Non-Infiltrating Bioretention systems are designed with impervious bottoms and sidewalls to prevent water from infiltrating into an underlying soil layer, and instead discharge stormwater via an underdrain. Bioretention planters can be considered as OSSM BMPs adjacent to buildings where roof drains can drain to them, with the impervious bottoms and sidewalls preventing stormwater from interfering with the building or its subsurface drainage system. Filter strips and biofiltration swales are non-infiltrating bioretention BMPs that can be considered for installation adjacent to parking lots, roadways or driveways in areas of campus that are less visible where they can be incorporated without compromising the Campus landscape design.

Non-Infiltrating Bioretention facilities also contribute to Water Quality treatment.

Non-Infiltrating Bioretention, Federal Way Library

Non-Infiltrating Bioretention, Edmonds, WA

Vegetated Roofs (Category 3)

Vegetated Roofs are listed as “Not Required, but Allowed” with respect to its implementation as an OSSM BMP for areas of the City that drain to a designated receiving water, as the UW Campus does.

While not required for evaluation, Vegetated Roofs can and should be considered as a way to meet OSSM requirements for building projects. Vegetated roofs occupy space that is otherwise not used, they do not require infiltration testing and they can be incorporated without compromising the Campus landscape design.

Large Green Roof, Seattle, WA

Green Roof Retrofit, Seattle, WA

Newly Planted Trees (Category 4)

Newly planted trees are incorporated into almost all development projects at the UW. While they do fall in the lowest OSSM category, they are counted towards OSSM requirements.

Not Feasible

The following OSSM BMPs are being considered as infeasible for implementation on the UW campus for the reasons described below.

Full Dispersion (Category 1)

Full dispersion applies to sites where at least 65% of the site is protected to remain in a forest or native condition. Campus projects define the "site" as the limits of work, where existing conditions are not maintained. This BMP therefore does not apply to Campus development.

Infiltration Trenches (Category 1)

Infiltration trenches introduce concentrated flows in discrete locations of a site. These concentrated flows cannot be introduced in areas that are adjacent to new or existing buildings due to the risk of water intrusion. Also, adding infiltration trenches to landscaped areas would compromise the Campus landscape design. For these reasons and the fact that campus subgrade does not infiltrate at the minimum required five inches per hour, this BMP is considered as infeasible for implementation on Campus redevelopment projects.

Dry Wells (Category 1)

Dry wells introduce concentrated flows in discrete locations of a site. These concentrated flows cannot be introduced in areas that are adjacent to new or existing buildings due to the risk of water intrusion. Also adding dry wells to landscaped areas would compromise the Campus landscape design. For these reasons reasons and the fact that campus subgrade does not infiltrate at the minimum required five inches per hour, this BMP is considered as infeasible for implementation on Campus redevelopment projects.

Infiltrating Bioretention (Category 2)

Infiltrating Bioretention introduces concentrated flows in discrete locations of a site. These concentrated flows cannot be introduced in areas that are adjacent to new or existing buildings due to the risk of water intrusion. Adding infiltrating bioretention to landscaped areas would not only compromise the Campus landscape design, but to a large extent would also dictate the type of vegetation that can be planted around them. Therefore this BMP is considered as infeasible for implementation on Campus redevelopment projects.

Concentrated Flow Dispersion (Category 3)

Concentrated flow dispersion requires a well-vegetated flowpath of at least 25-feet, which is not feasible criteria to incorporate into a campus project.

Splashblock Downspout Dispersion (Category 3)

Splashblock downspout dispersion requires a well-vegetated flowpath of at least 50-feet, which is not feasible criteria to incorporate into a campus project.

Trench Downspout Dispersion (Category 3)

Trench downspout dispersion requires a well-vegetated flowpath of at least 25-feet, which is not feasible criteria to incorporate into a campus project.

Perforated Stub-Out Connections (Category 4)

Perforated stub-out connections require a perforated pipe surrounded by gravel as a means of stormwater conveyance from a building to a storm main. Due to the extensive amount of planting on campus, the risk of root intrusion into such a system makes this BMP infeasible for installation on campus projects.

APPENDIX D

Transportation Discipline Report

UNIVERSITY OF WASHINGTON

2018 SEATTLE CAMPUS MASTER PLAN

FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX D
FINAL TRANSPORTATION DISCIPLINE REPORT

JULY 2017

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1 INTRODUCTION

As an incremental step towards implementing the University of Washington's long-term campus vision, this *Transportation Discipline Report* and related *2018 Campus Master Plan* (CMP) *Environmental Impact Statement* (EIS) evaluate a maximum of 6 million square footage of net new development. This level of development is anticipated to be necessary to accommodate population and University growth over the 10-year, 2018–2028 planning horizon under a range of development options. Development beyond this 6 million gross square footage (gsf) of net new development would need to be addressed in future environmental review(s). Because the effects of transportation relate closely to the behavior of campus population, transportation and growth are analyzed based on forecasts of population (students, faculty, and staff) as noted in the alternatives discussion (Chapters 4 through 8), and travel modes.

Section 1.1 presents information related to the trip and parking caps that the University of Washington has agreed to; these caps have maintained traffic impacts below 1990 levels. This section includes local and national comparisons to neighborhoods and peer institutions, thus demonstrating the University of Washington's success at limiting vehicle impacts. Section 1.2 presents a high level preview of the report organization and content, following by a description of the alternatives in Section 1.3.

1.1 VEHICLE TRIP LIMITS—TRIP AND PARKING CAPS

The University of Washington and the City of Seattle entered an agreement referred to as the City-University Agreement (CUA) in 1998. This agreement defines maximum parking and vehicle trip "caps" that the University has agreed not to exceed. The caps were developed as part of the Transportation Management Plan developed for the University of Washington to meet the goal of limiting peak-period, peak direction vehicle trips of students, staff, and faculty to 1990 levels. The CUA allows for amending these Caps with the adoption of a new CMP. To date, the University of Washington has met these aggressive goals, while continuing to grow through strategies that reduce drive-alone behavior. The University has not exceeded these caps, which are described below, even as the population on the campus has grown. The trip caps can be changed in a new Master Plan.

CUA (City-University Agreement): An agreement between the City of Seattle and the University of Washington that among other things, defines various transportation thresholds.

Trip Caps: Developed as part of the Transportation Management Plan for the University of Washington to meet the goal of limiting peak-period, peak direction vehicle trips of students, staff, and faculty to 1990 levels.

UNIVERSITY DISTRICT CAPS – University of Washington vehicle trips in the University District, including beyond the Major Institution Overlay (MIO) boundary:

- AM peak period (7–9 AM) trip cap is **10,100 inbound**
- PM peak period (3–6 PM) trip cap is **10,500 outbound**

UW CAMPUS CAPS – University of Washington vehicle trips inside the MIO boundary:

- AM peak period (7-9 AM) trip cap is **7,900 inbound**
- PM peak period (3-6 PM) trip cap is **8,500 outbound**

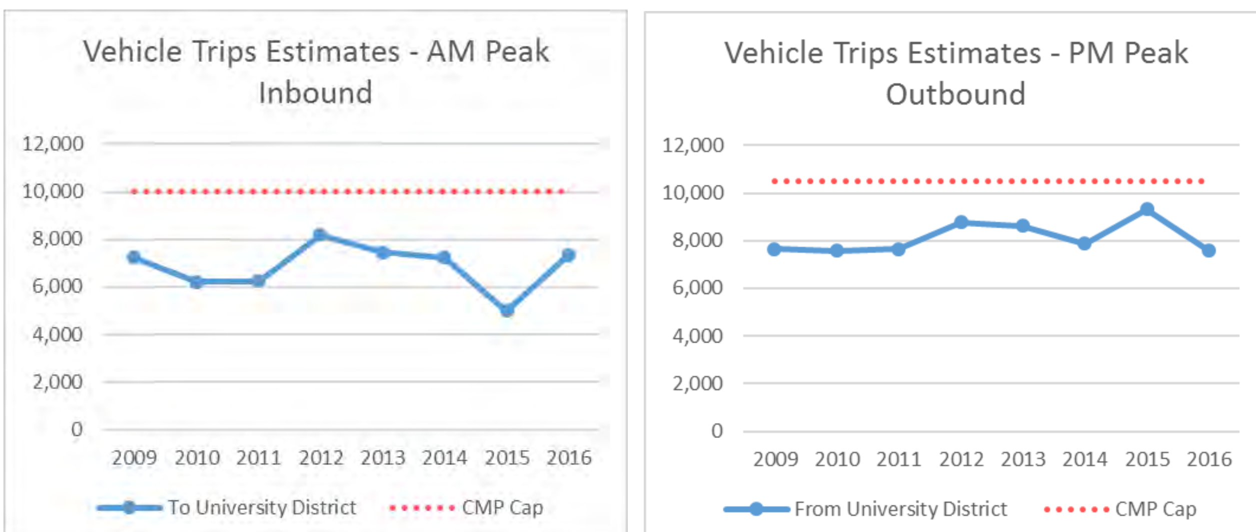
The maximum parking space cap is 12,300 spaces. This parking space cap does not include service and load zones, cycle spaces, accessory off-campus leased spaces, and spaces associated with student housing.

These caps are evaluated in more detail for each alternative in Sections 4 through 8.

U-PASS: The University of Washington's U-PASS program provides students, faculty, and staff with subsidized access to transit. Participating local agencies include King County Metro, Sound Transit, Community Transit, Pierce Transit, Kitsap Transit, and Everett Transit, as well as the King County Water Taxis and Seattle Streetcar. Unlimited rides on these transit agencies are free with the Student U-PASS, and discounts for Zipcar and car2go are also included. The Student U-PASS includes an $84 per student mandatory fee incorporated into quarterly tuition. The University's Employee U-PASS includes the same benefits as the Student U-PASS for $150 per calendar quarter.

Additional terms and descriptions can be found in **Appendix A**.

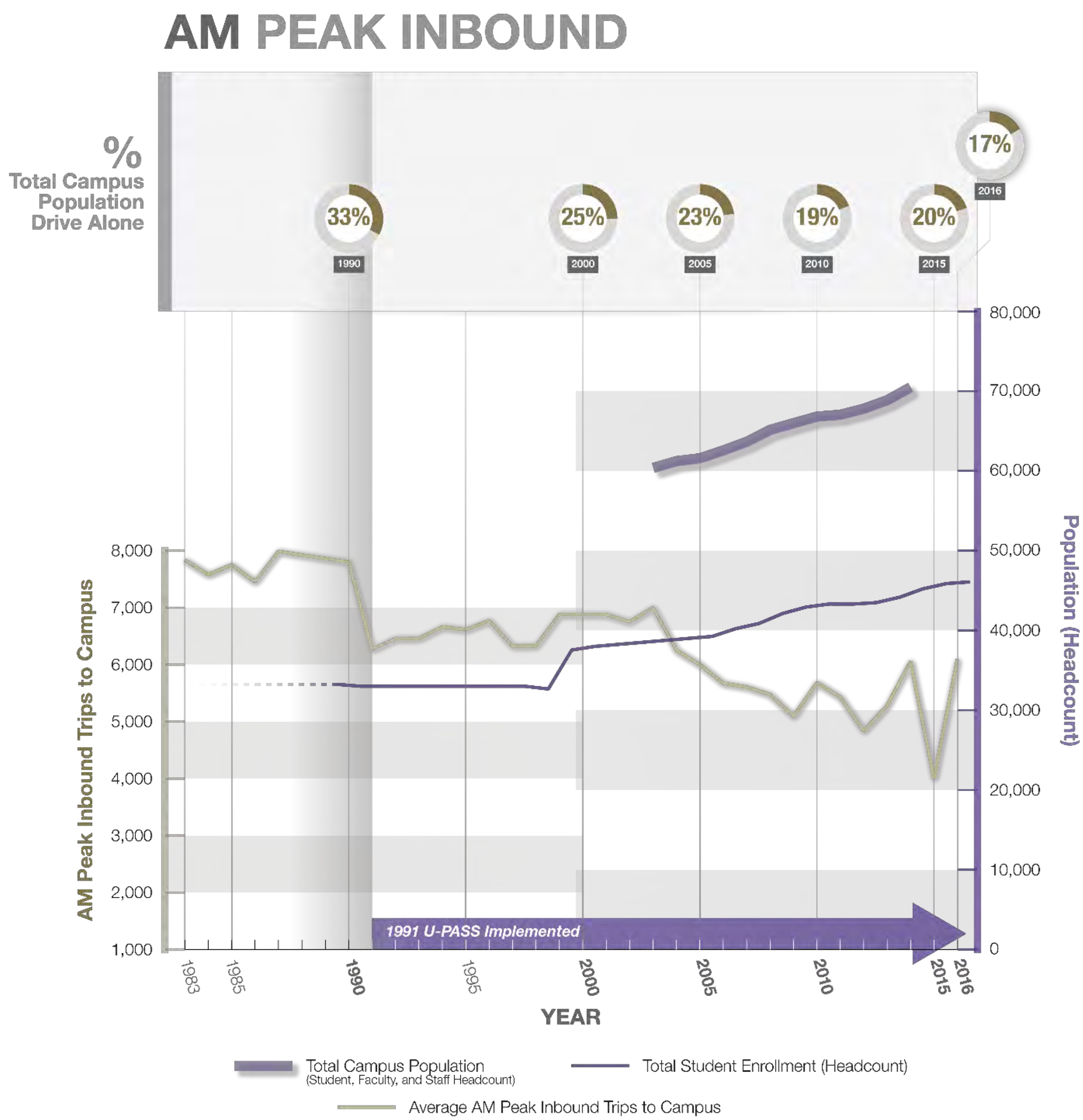
Historical Performance. The University's Transportation Management Plan can be credited for the implementation of the innovative U-PASS program and supporting strategies implemented in 1991. Transportation mode choices changed dramatically with the addition of this program. The University's U-PASS program subsidizes transit use with the addition of a transit pass included with a University member's Husky Card. The U-PASS has resulted in a substantial decline in vehicle trips to and from the University of Washington—specifically during peak commute periods. Figure 1.1 shows the historical performance of the University under the University District caps. Similarly, the University has remained under the caps.



Source: Transpo Group, 2016

Figure 1.1 Historical University Performance under Parking and Trip Caps

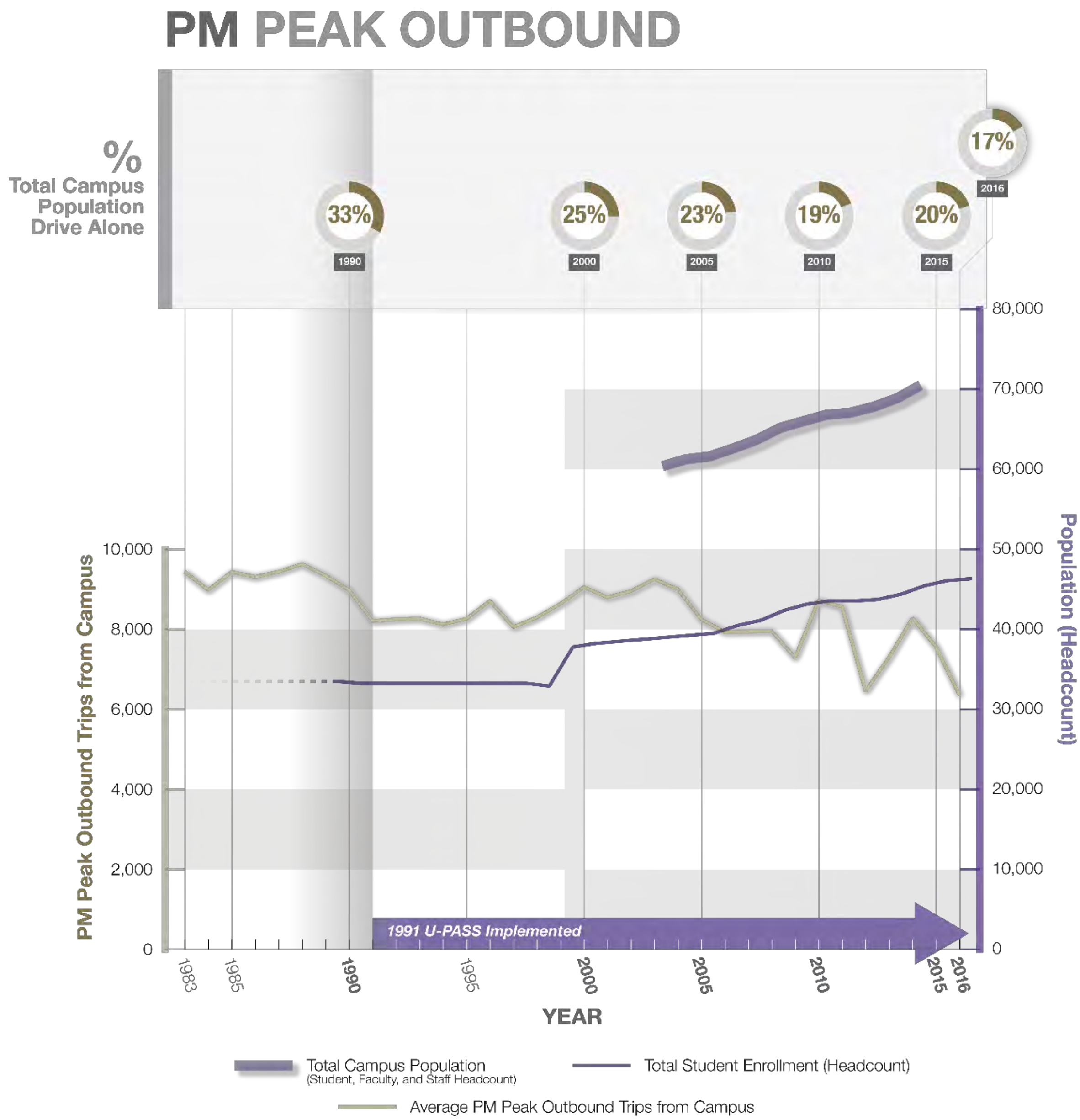
In 2003, additional locations from East Campus were added to the annual traffic count monitoring program. Average peak hour trips are shown in Figure 1.2 and Figure 1.3, in comparison to total student enrollment, including data from 1999 and 2006–2016. Peak hour trips to and from campus have declined since the implementation of the U-PASS program, despite increased student enrollment and faculty and staff employment. Notably, while student enrollment (headcount) increased, vehicle trips to the campus declined. Figure 1.2 shows how the U-PASS program has limited vehicle trips during the weekday AM peak hour. It contrasts trips with recent growth in campus population and compares trips to student enrollment. Figure 1.3 illustrates the effects of the U-PASS program on vehicle trips during the weekday PM peak hour and contrasts with recent growth in campus population. Like AM peak hour inbound trips, PM peak hour outbound vehicle trips declined while enrollment grew.



Note: Some student enrollment data and 2015 trip data not available

Source: Annual Campus Traffic Count Data Collection Summary, University of Washington Commuter Services

Figure 1.2 Effects of U-PASS Program on AM Peak Inbound Trips in Comparison to Recent Growth in Student Enrollment



Note: Some student enrollment data and 2015 trip data not available

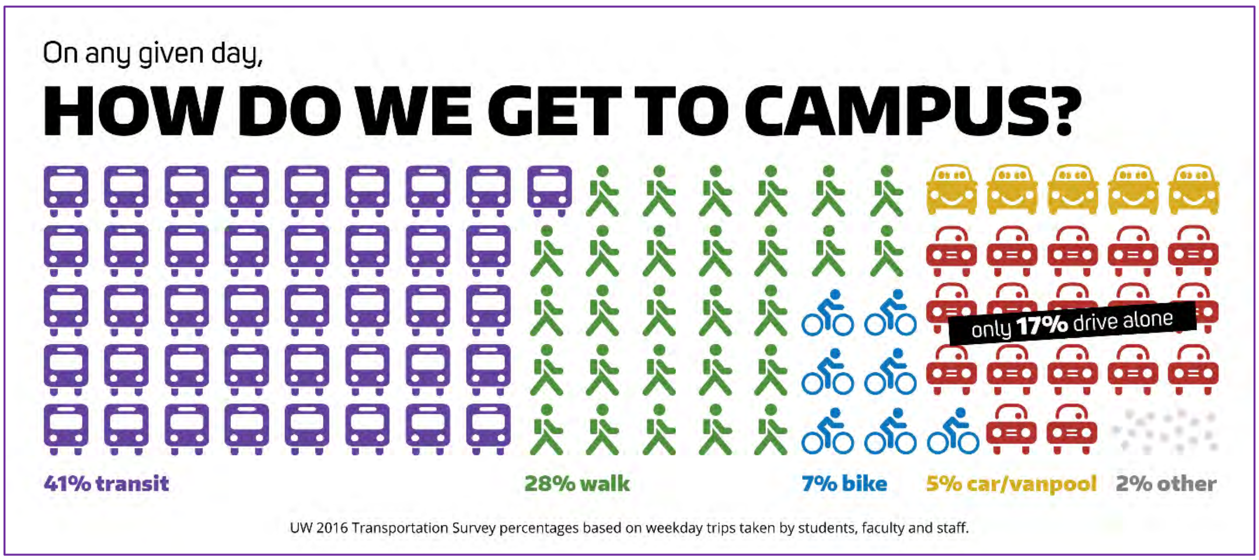
Source: Annual Campus Traffic Count Data Collection Summary, University of Washington Commuter Services

Figure 1.3 Effects of U-PASS Program on PM Peak Outbound Trips in Comparison to Recent Growth in Student Enrollment

What are the Initial Effects of Light Rail at the University of Washington? In March 2016, Link light rail opened near the University of Washington Husky Stadium to connect the University to Capitol Hill, Downtown Commercial Core, and Sea-Tac Airport. Link light rail provides fast, reliable, high-capacity access to these destinations and other areas connecting to Downtown Seattle. The most recent annual survey (University of Washington 2016 Transportation Survey) suggests that drive-alone mode split is now lower.

Drive alone mode shift assumption. Drive alone mode split went from 20 percent in 2015 to 17 percent in 2016 due in part to increased transit use. While the recent survey suggests the drive-alone mode is going down as a proportion of overall trips, this transportation analysis supporting the CMP and EIS has been conducted using the more conservative 20 percent drive-alone mode.

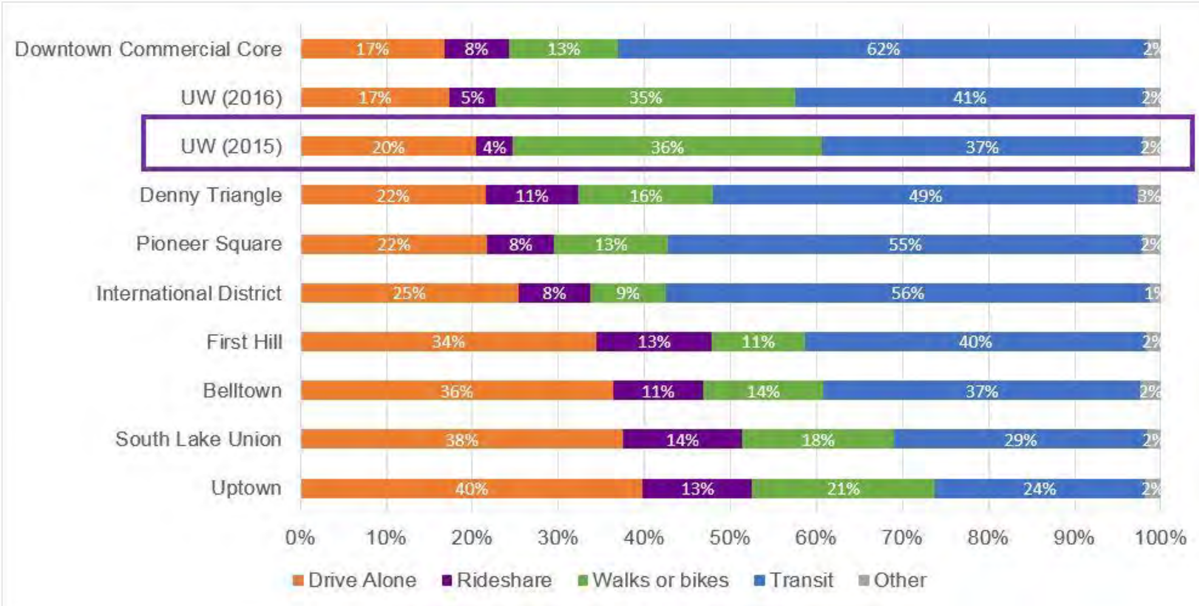
How Does the University of Washington Mode Split Compare Locally and Nationally? The University of Washington mode share, illustrated in Figure 1.4, performs very well both locally (compared to other urban neighborhoods) and nationally (compared to peer institutions).



Source: University of Washington Transportation Services (UWTS)

Figure 1.4 University of Washington 2016 Mode Share

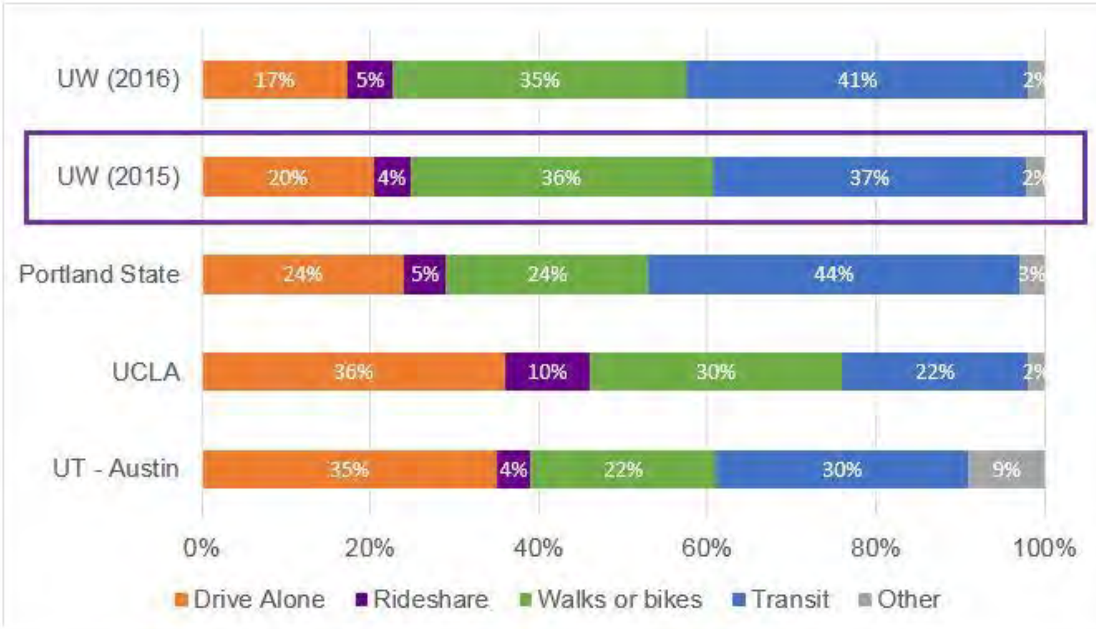
As compared to other Seattle neighborhoods, the University of Washington has one of the most successful programs for limiting drive-alone vehicular demand. Figure 1.5 shows a comparison of the University of Washington mode splits to other neighborhoods in Seattle. As shown, the campus operates with the lowest drive-alone percentage (just 20 percent) compared to these neighborhoods.



Source: Commute Seattle Center City Commuter Mode Split Survey, 2016 and University of Washington, 2016

Figure 1.5 Existing Neighborhood Mode Share Comparison

The University of Washington also compares well when considering large peer universities in urban cities with developing transit systems, as shown in Figure 1.6. Compared to nearby Seattle University, another university in a Seattle urban neighborhood, University of Washington has maintained a much lower drive alone percentage. For example, in 2007, Seattle University reported a 39 percent drive-alone percentage as compared to 23 percent reported at University of Washington for the same year.



Source: Transpo, 2016; University of Washington, Portland State University, University of California – Los Angeles, and University of Texas – Austin

Figure 1.6 Existing Peer University Mode Share Comparison

For each of the transportation system elements, the analysis in the report considers the existing and future facilities and volumes. The impacts of the development alternatives are measured based on a comparison of No Action conditions to conditions under the development alternatives. The degree of the impacts as reported inform the nature and level of mitigation that may be necessary to offset significant impacts. Where significant impacts cannot be mitigated, those are identified as significant unavoidable adverse impacts.

1.2 REPORT ORGANIZATION AND CONTENT

This report includes the following main sections:

- **Section 1.0 Introduction** – Provides a description of the alternatives, defines the study area for the analysis, and provides a general framework for the analysis.
- **Section 2.0 Analysis Methodology and Assumptions** – Defines the primary analysis assumptions, including the study area, horizon years, City investments, and performance measures for each of the travel modes evaluated within this report.
- **Section 3.0 Affected Environment** – Describes the existing conditions in the study area.
- **Section 4.0 Impacts of No Action** – Summarizes the analysis and impacts of the No Action Alternative on the transportation system.
- **Section 5.0 Impacts of Alternative 1** – Summarizes the analysis and impacts of Alternative 1 on the transportation system.

- **Section 6.0 Impacts of Alternative 2**– Summarizes the analysis and impacts of Alternative 2 on the transportation system.
- **Section 7.0 Impacts of Alternative 3** – Summarizes the analysis and impacts of Alternative 3 on the transportation system.
- **Section 8.0 Impacts of Alternative 4** – Summarizes the analysis and impacts of Alternative 4 on the transportation system.
- **Section 9.0 Mitigation –** Summarizes the mitigation identified for each alternative. This includes physical improvements or elements of the TMP.
- **Section 10.0 Significant Unavoidable Adverse Impacts** – Identifies any significant unavoidable adverse impacts associated with any of the development alternatives
- **Section 11.0 Summary of Impacts** – Summarizes the impacts of each alternative in a comparative format. Outlines the significant impacts identified and recommended mitigation measures.

The evaluation was conducted in accordance with City of Seattle State Environmental Policy Act (SEPA) standards and analyzes impacts on the following transportation elements:

- Pedestrians (safety, connectivity, capacity)
- Bicycles (safety, connectivity, parking)
- Transit (connectivity and capacity)
- Traffic Operations (intersection and corridor operations)
- Traffic Safety (collision history, trends)
- Parking (demand versus supply)
- Freight/Service (operations, patterns)

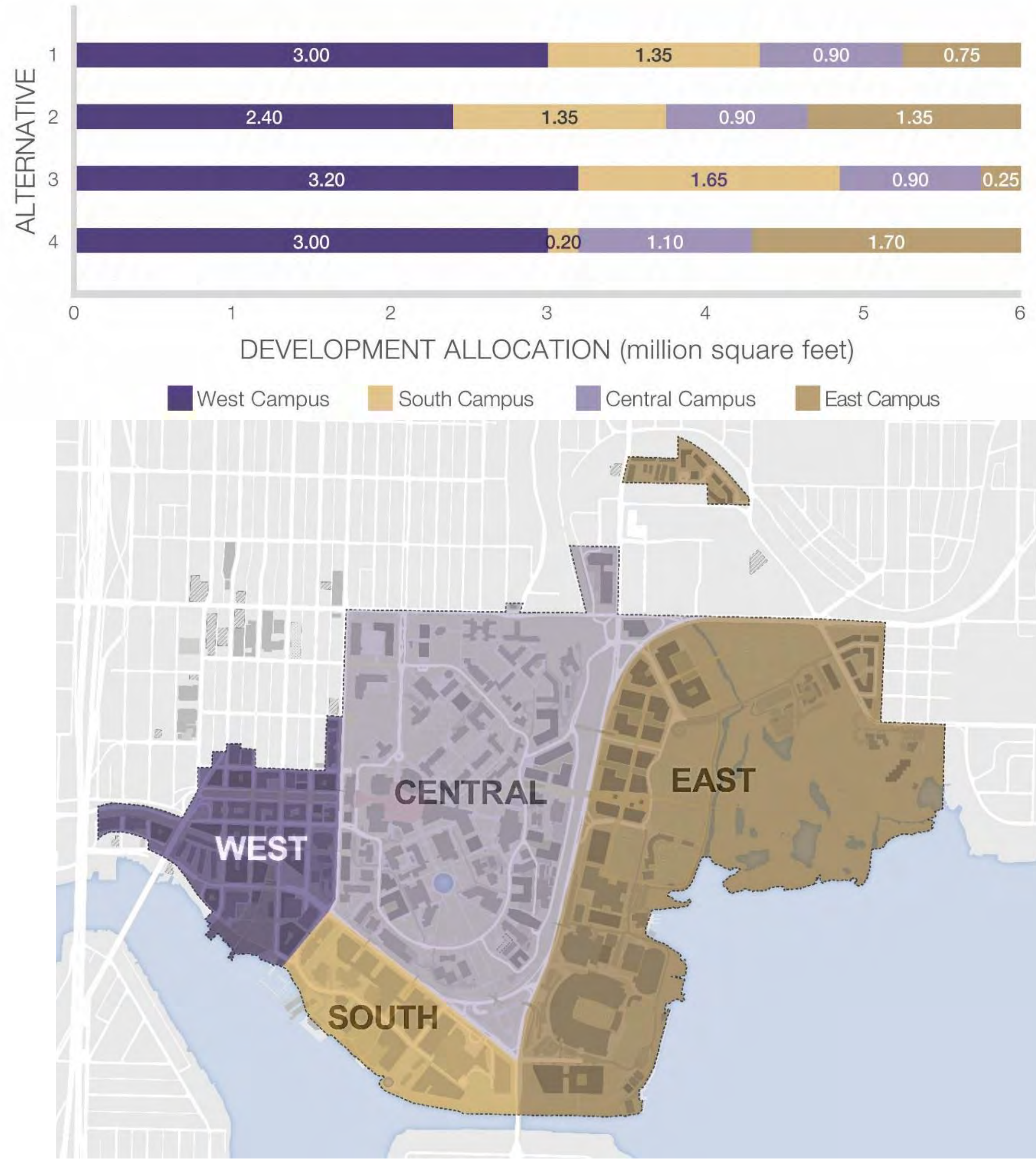
The CUA, impacts are disclosed both in terms of the comparison to the identified No Action Alternative and to the trip and parking caps that were established. This approach helps ensure that impacts are considered in both the discreet short term and in terms of the historical context that exists between the University of Washington and the City of Seattle.

1.3 DESCRIPTION OF ALTERNATIVES

As noted in the introduction, this Transportation Discipline Report (TDR) evaluates a No Action Alternative as compared to four variations of development alternatives, each with up to 6 million square footage of new development on campus, within the MIO. Each of these alternatives (1 through 4) apportion this development to campus sectors in different ways. This section provides a general description of the alternatives. Specific details of each alternative as they relate to the multimodal elements are reflected in the subsections for each alternative.

MIO (Major Institution Overlay): The Major Institution Overlay is a boundary defined by the City of Seattle Land Use and Zoning Code, noting the extents of the University of Washington.

Figure 1.7 shows the campus sectors as referenced in the description of the alternatives. The University of Washington campus has four distinct sectors today: West, South, Central, and East. All are described in terms of potential net new increase in development area relative to the No Action Alternative conditions. As shown in Figure 1.7, the development alternatives (Alternatives 1 through 4) differ in how the 6 million square footage of proposed development is apportioned to these sectors. The assignment of development square footage is shown graphically in the bar charts at the top and the sectors are noted in the map below the bars.



Source: Transpo, 2016

Figure 1.7 Campus Sectors

The development of the 6 million square footage has been identified to reflect a projected growth in head count (or population) anticipated and associated University space needs between 2018 and 2028. The population is usually defined in terms of full time equivalent (FTEs) but for this study it is converted to headcount as a basis for estimating the anticipated increase in campus-related trip generation by mode. The population forecasts used in the alternatives analysis are summarized below in Table 1.1, where the 2028 population is reflected according to the development of a net new 6 million gross square footage. As shown the University population is expected to increase by approximately 15,676 people over the 2014 population. This growth includes an additional 211,000 gross square footage of net new development that is permitted under the current 2008 Campus Master Plan. This 211,000 gross square footage is assumed as the future No Action Alternative.

Table 1.1
EXISTING (2014) AND ESTIMATED FUTURE (2028) UNIVERSITY POPULATION (HEADCOUNT)

Population	2014 (Actual)	2028 (Estimated)	Growth (Estimated)
Students	45,213	54,183	8,970
Faculty	7, 951	9,528	1,577
Staff	17,333	22,462	5,129
Total	**70,497**	**86,173**	**15,676**

Source: Sasaki Architects, Inc., 2016.

In general, this transportation analysis evaluates the growth in campus population for three components—students, faculty, and staff—to fully analyze transportation impacts. This method takes into account that each University population (students, faculty, and staff) have different travel behaviors.

1.3.1 No Action Alternative

For the purposes of this analysis, the No Action Alternative assumes the remaining development under the 2003 CMP, approximately 211,000 gsf of building capacity, would be developed in West Campus**.** It should be noted that this capacity may be constructed in any of the campus sectors, but it has been allocated to the West Campus for study purposes.

Headcount: A quantifiable count of individuals within the University of Washington population. Headcount differs from a Full Time Equivalent (FTE) count, which converts actual campus enrolled and employed students, faculty, and staff to a full time equivalency based on 8-hour days and a 40-hour work week.

CMP: Campus Master Plan, or a document guiding development on campus and within the MIO that determines how the campus can grow in the coming years while minimizing impacts to the community. The most recent University of Washington CMP for the Seattle campus was completed in 2003. A new plan is being developed for the 2018 to 2028 planning horizon.

1.3.2 Alternative 1 – CMP Proposed Allocation with Requested Height Increases

As shown in Figure 1.8, Alternative 1 has a West and South Campus development focus. This alternative includes increases in height. Under Alternative 1, NE Northlake Place east of 8th Avenue NE would be vacated. The anticipated campus sector development is as follows:

- West Campus: 3.0 million gsf
- South Campus: 1.35 million gsf
- Central Campus: 0.9 million gsf
- East Campus: 0.75 million gsf

Development on West, South, and Central Campus (indicated in purple below) represents a net increase over the existing developed areas. It is assumed that parking would be developed as part of the building development in each sector.

Source: Sasaki Architects, July 2017 CMP

Figure 1.8 Alternative 1 Potential Development Sites Representing Sector GSF

1.3.3 Alternative 2 – CMP Proposed Allocation with Existing Height Limits

As shown in Figure 1.9, Alternative 2 has a West and East Campus development focus. This alternative would include the same NE Northlake Place vacation as described in Alternative 1. The anticipated campus sector development is as follows:

- West Campus: 2.4 million gsf
- South Campus: 1.35 million gsf
- Central Campus: 0.9 million gsf
- East Campus: 1.35 million gsf

Source: Sasaki Architects, July 2017 CMP

Figure 1.9 Alternative 2 Potential Development Sites Representing Sector GSF

1.3.4 Alternative 3 – Campus Development Reflecting Increase West and South Campus Development

As shown in Figure 1.10, Alternative 3 has a West and South campus development focus. This alternative would include the vacation as described in Alternative 1. The anticipated campus sector development is as follows:

- West Campus: 3.2 million gsf
- South Campus: 1.65 million gsf
- Central Campus: 0.9 million gsf
- East Campus: 0.25 million gsf

Source: Sasaki Architects, July 2017 CMP

Figure 1.10 Alternative 3 Potential Development Sites Representing Sector GSF

FINAL

1.3.5 Alternative 4 – Campus Development Reflecting Increase West and East Campus Density

As shown in Figure 1.11, Alternative 4 has a West and East campus development focus. This alternative would include NE Northlake Place vacation as described in Alternative 1. The anticipated campus sector development is as follows:

- West Campus: 3.0 million gsf
- South Campus: 0.2 million gsf
- Central Campus: 1.1 million gsf
- East Campus: 1.7 million gsf

Source: Sasaki Architects, July 2017 CMP

Figure 1.11 Alternative 4 Potential Development Sites Representing Sector GSF

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2 ANALYSIS METHODOLOGY & ASSUMPTIONS

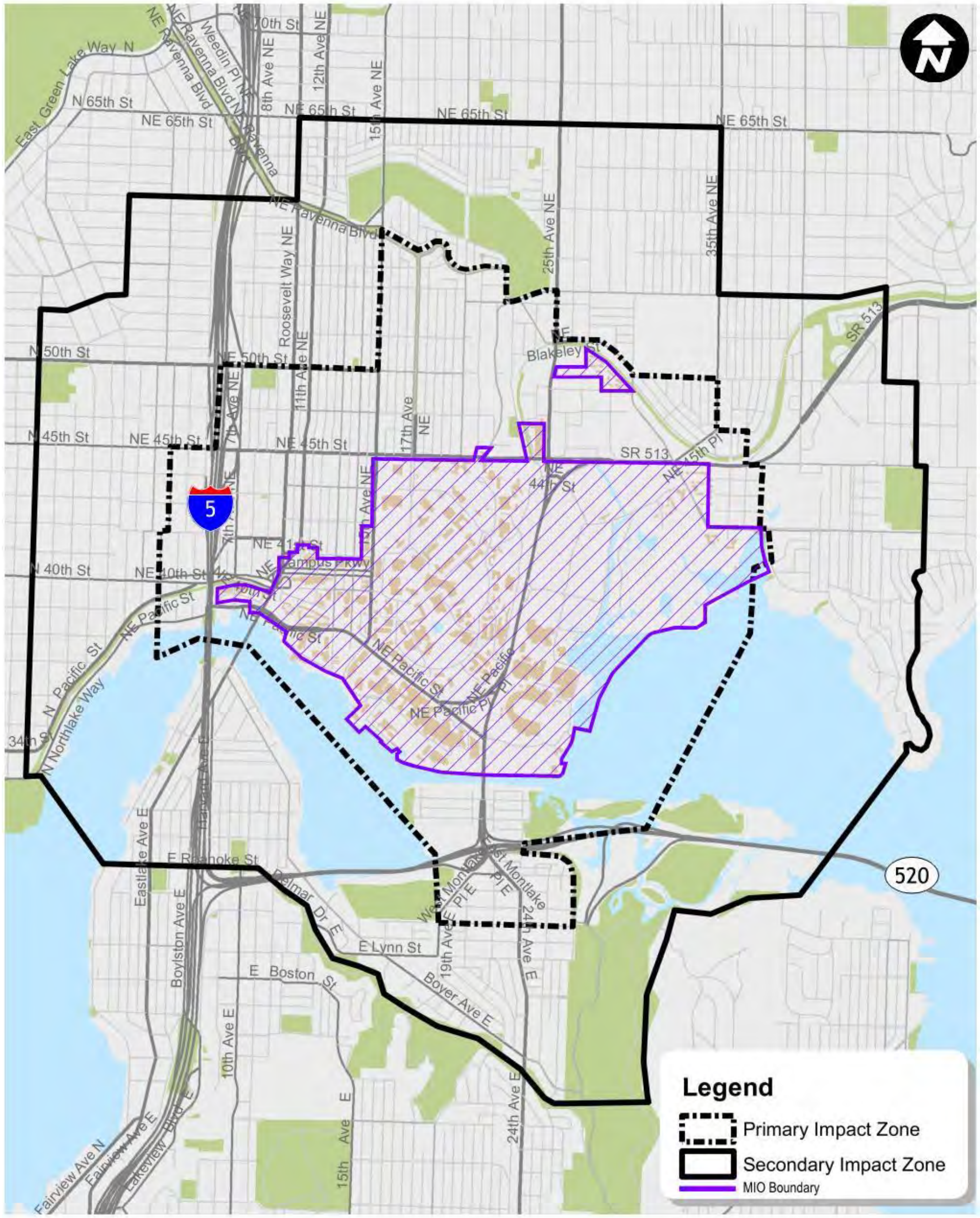
This section describes the methodology for evaluating the proposed alternatives' effects on transportation systems for the University of Washington 2018 Campus Master Plan (CMP*)* EIS. It describes analysis parameters, including the study area limits, analysis years, background transportation investments, analysis time periods, performance measures for modes and methods for calculating them, and performance thresholds. Appendix B provides more depth, data, and technical analysis supporting this section.

2.1 STUDY AREA

CUA (City-University Agreement): An agreement between the City of Seattle and the University of Washington that among other things outlines the elements that will be responded to in the CMP and EIS. It also identifies which thresholds can be changed with the adoption of the CMP.

To evaluate impacts of the new CMP, this analysis explores the potential impacts consistent with the City-University Agreement[1] (CUA), which defines the primary and secondary impact zones. Evaluation and monitoring of the transportation-related impacts of the University will be conducted within these zones. Thus, the primary and secondary impacts zone boundaries serve as the project study limits. As the names suggest, growth at the University of Washington is expected to have greater impacts in the primary impact zone, with lesser impacts in the secondary impact zone. For this reason, the analysis conducted in the primary impact zone is more detailed, while analysis in the secondary impact zone is less detailed. The boundaries of the primary and secondary impact areas are shown in Figure 2.1.

[1] 1998, City University Agreement amended November 29, 2004



Source: CUA and Transpo Group, 2017

Figure 2.1 University of Washington Primary/Secondary Transportation Impact Zones

2.2 HORIZON YEAR/ANALYSIS PERIODS/BACKGROUND IMPROVEMENTS

The CMP reflects a 10-year planning horizon with a base year for development beginning in 2018 and extending to 2028. A general list of the City of Seattle and regional transportation investments anticipated between 2016 and 2028 are noted in Table 2.1. These investments are considered as part of the background conditions for the different transportation modes.

Table 2.1
BACKGROUND IMPROVEMENTS BY 2028

Type of Improvements	Description
Pedestrians	• New multiuse trail across the Montlake Cut connecting the University of Washington with the Washington Park Arboretum as part of the Move Seattle Levy. • Continued modifications of the regional Burke-Gilman trail through the University of Washington. • Green streets, are intended to enhance and expand public open space and give priority to pedestrian circulation and open space over other transportation uses. Green streets use treatments that may include sidewalk widening, landscaping, traffic calming, and other pedestrian-oriented features. Brooklyn Avenue, NE 43rd Street, and NE 42nd Street are designated green streets in the University District. The Seattle Pedestrian Master Plan identifies gaps and defines systems such as Green Streets but does not define funded improvements in the area.
Bicycles	• As part of the Move Seattle Levy, protected bicycle lanes on 15th Avenue, N 50th Street and 35th Avenue NE and bicycle lanes on Brooklyn Avenue N are proposed but are not funded and cannot be assumed to be in place by 2028. Other routes and improvements have been identified in the Seattle Bicycle Master Plan but are currently not funded.
Transit	• The Seattle Transit Master Plan (TMP) identifies Multimodal Transit Corridor enhancements along Roosevelt Way NE/11th Avenue NE/Eastlake Avenue NE, 15th Avenue NE/NE Pacific Street/23rd Avenue NE (extension of Montlake), and Market Street/NE 45th Street. • Completion of Sound Transit 2 (ST2) extension of Link light rail from the University of Washington Station to Lynnwood, including an additional light rail station near campus (University District at Brooklyn Avenue). Completion of other Link extensions to Overlake and Kent as part of ST2 by 2023 and to Federal Way and Redmond as part of ST3 in 2024. ST3 also identifies development of BRT along SR 522 in 2024 which would improve speed and reliability for bus service between the University Campuses. • Expansion of King County Metro Express, Frequent/RapidRide, and Local service identified in METRO CONNECTS*,* the King County Metro Long-Range Plan by 2025. Is assumed as a logical service plan; however, this plan is not fully funded.
Vehicle	• A second Montlake Boulevard Bascule Bridge has been identified as part of the SR 520 Bridge Replacement project, which is funded as part of the Connecting Washington Partners Projects and expected to be completed by 2027.
Freight	• The Seattle Freight Master Plan includes designation of a network prioritized for use by freight. This plan identifies NE 45th Street, Pacific Street, Montlake Avenue, and the Roosevelt Way/11th Avenue NE couplet as Minor Truck Streets. No freight investments are identified in the project area.

Source: State Route 520 Bridge Replacement and HOV Project High Capacity Transit Plan (2008), King County Metro Draft Long-Range Plan Summary (2016), Sound Transit 2 (2008), City of Seattle Draft Pedestrian Master Plan (2016), City of Seattle Bicycle Master Plan (2015), City of Seattle Transit Master Plan (2016), and City of Seattle Draft Freight Master Plan, U District Green Streets Concept Plan (2015).

For guiding future City of Seattle infrastructure investments, the City has developed modal plans (Pedestrian Master Plan, Bicycle Master Plan, Transit Master Plan, and Freight Master Plan) that identify projects and corridor needs. These plans support an aspirational long-range (often 20-year) horizon and may not include implementation timelines nor details on how infrastructure could change. Where details are provided on implementation of investments—for example lane designations or modifications—those changes have been reflected as part of the background analysis and carried forward in the analysis of alternatives.

METRO CONNECTS: The METRO CONNECTS service network is a long-range vision that will require additional resources beyond current King County Metro revenue sources to implement. As such, the service network depicted does not represent a revenue-backed service plan, and refinements to this vision through plan updates and service processes are expected. Continued coordination between King County Metro and the University of Washington will be critical to achieving the transportation and mode shift outcomes made possible by the METRO CONNECTS service network

2.3 ANTICIPATED BACKGROUND AND PROPOSED GROWTH

The City of Seattle has adopted its 2035 Comprehensive Plan (November 2016) as well as the U District Rezone proposal (February 2017) that identifies increased density and heights in the University District surrounding the Link light rail University District Station. The City's 2035 Comprehensive Plan includes an increase of 120,000 residents and 115,000 jobs citywide by 2035. The U District Urban Design process suggests a potential increase in building heights over the 2035 Comprehensive Plan levels.

For this analysis, background growth was interpolated from the 2035 Comprehensive Plan traffic volumes, which were developed using the City-developed travel demand model, to reflect the 2028 horizon year. Land use and traffic as part of the recently adopted U District rezone proposal was also assumed as part of the background future analysis. In addition to vehicle traffic, the City-developed travel demand model provides background growth related to transit, pedestrians, and bicycles.

Alternative Population Assumptions: The No Action Alternative assumes 211,000 net new gross square footage (gsf) of development and a population increase of 1,465 people. All of the action alternatives (Alternatives 1-4) assume an additional 6 million net new gsf of development ***on top of*** the No Action 211,000 gsf. The University population for all action alternatives includes the population increase anticipated with No Action, so the 15,676 growth in population includes the 1,465 anticipated with No Action.

For the purposes of the transportation section of the EIS and this report, campus growth reflective of increased building square footage is translated to trips related to the various campus population groups, specifically students, faculty, and staff. As noted in Chapter 1, all development alternatives would result in expanded development on campus of 6 million net new gross square footage (gsf) on top of No Action increased development on campus of 211,000 net new gsf by the plan horizon year of 2028.

Table 2.2 summarizes the growth in campus population that would result from this level of development.

Table 2.2
UNIVERSITY POPULATION AND FUTURE GROWTH

Population	Existing (2014) Headcount[1]	No Action 2028	Growth over Existing with No Action Alternative	All Development Alternatives 2028[2]	Total Growth over Existing with Action Alternatives[2]
Students	45,213	46,152	939	54,183	8,970
Faculty	7,951	8,117	166	9,528	1,577
Staff	17,333	17,693	360	22,462	5,129
Total Population	70,497	71,962	1,465	86,173	15,676

1. 2014 was the most recent available information.
2. Population numbers include No Action Alternative growth (211,000 gross square footage).

An in-depth discussion and details related to the development of background growth, growth related to CMP development alternatives, and parking estimates analysis are provided in Appendix B, Methods and Assumptions.

2.3.1 CMP Development Trip Generation

Growth in traffic and visitors related to the proposed CMP alternatives, including No Action, were developed based on growth in campus population and are reflective of the anticipated development patterns of buildings apportioned by the West, South, Central, and East campus sectors. Recognizing that the campus is fairly fluid, with people moving across the campus throughout the day, for the purposes of evaluating trip impacts and growth in different sectors, new trips were assigned to campus sectors based on the proportion of overall development growth in each sector and transportation patterns.

CMP (Campus Master Plan): The University of Washington's CMP guides development on campus and within the Major Institution Overlay (MIO), which determines how the campus can grow in the future while minimizing impacts to the community. The most recent University of Washington CMP for the Seattle campus was completed in 2003 and is being updated for 2018.

2.3.2 Parking

Development related to the CMP alternatives will also require some replacement or expansion of parking. In many cases, development could occur where current surface parking sites exist. This would require replacement of parking removed as well as accommodation of parking demands resulting from that increased development. For the purposes of this transportation analysis, parking demand was forecasted based on current parking data, including peak demand periods, supply, parking utilization throughout the campus, and visitors. Parking demand resulting from the alternatives was projected for each campus sector by applying the ratio of the current parking utilization to the current development and then applying that factor to future growth by sector to estimate future parking demand. In estimating spaces

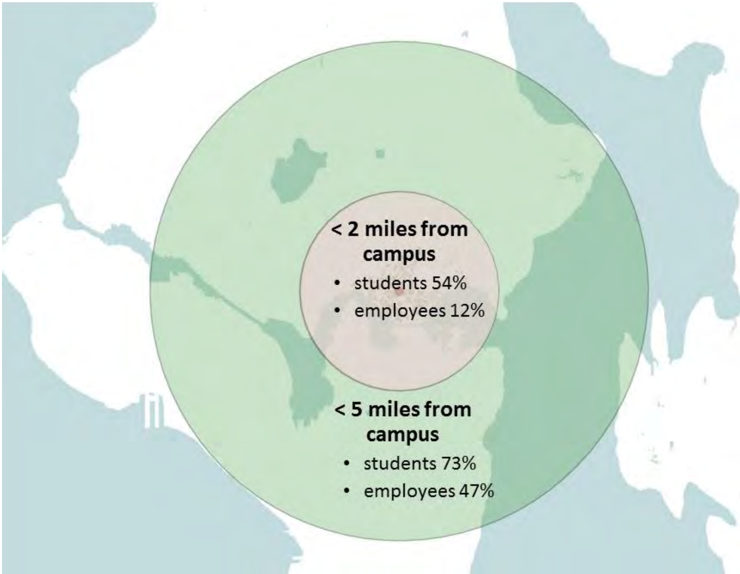
2.3.3 Visitors

With campus growth, there is also an anticipated level of growth in visitors related to new buildings. Based on campus parking data and anecdotal data from other universities, trips from visitors range from 5 to 10 percent. For the purposes of this analysis, trips from visitors were assumed to be 10 percent of the total increased trips. Visitors are encouraged to access the campus using alternatives to driving alone through information on the website and offering options on the City website. Specific details on the methods and assumptions in developing trip and parking generation are provided in Appendix B.

2.3.4 Distribution of Trips

The University of Washington campus is a unique environment where a large number of students live nearby and on campus. General distribution patterns for students, faculty, and staff were estimated based on the Comprehensive Plan 2035 travel demand model and campus surveys.

Data from the University of Washington indicate that currently more than half of the students and over 10 percent of the employees (faculty and staff) live within 2 miles of the campus, as shown in Figure 2.2 These amounts increase to almost 75 percent for students and almost half of employees when the distance increased to 5 miles. The 2035 City of Seattle travel demand model provides distribution patterns based on regional growth, changing modes, and expansion of transit.



Source: Transpo Group 2016.

Figure 2.2 Proportion of Students and Employees within 5 Miles of Campus

The increase of transit use related to new light rail access at University of Washington is expected to increase access to the University by fast, reliable transit modes. As evidenced by the immediate increase of ORCA taps (see Table 2.3) by University members using light rail, access to light rail should increase the transit mode for students, faculty, and staff. As shown in Figure 2.3 and Table 2.3, using current employee (staff and faculty) home zip code data, extension of light rail will be within convenient access for University employees. Of current employees, 24 percent live in a zip code adjacent to convenient light rail. Considering that light rail is a convenient travel destination to the University, estimates of access to light rail for all employees in adjacent zip codes in the future as light rail expands are as high as 59 percent.

ORCA, the One Regional Card for All, is a fare card providing access to the public transit buses and trains serving the Puget Sound region including the University of Washington. ORCA is incorporated into the U-PASS. By tapping the card on the bus at card readers on the bus or at stations, boarding is facilitated more efficiently than paying with cash, which is still accepted on bus service.

Connection to light rail—specifically to Sounder commuter train users, who can access light rail at the International District/Chinatown Station—has also become more convenient for locations in Pierce and Southeast King County. These connections have resulted in a 10 to 25 percent increase in Sounder-to-light rail “taps” by University-related ORCA cards as compared to 2015 (pre-light rail). As shown in Table 2.3, only 6% of the University employees (faculty and staff) live within walking distance of light rail and Sounder commuter rail. This increases to 10% with extension of light rail to Lynnwood. The proportion of employees that live adjacent (in the same zip code) of light rail or commuter rail is also shown in Table 2.3. This suggests that the proportion of employees with convenient access (through drop-offs, or other transit connection) in zip codes adjacent to light rail or commuter rail increases dramatically from just over a quarter to more than 60 percent as the system expands.

Access to rail transit Access to transit by walk mode is encouraged and for light rail it is assumed that many can walk, bike or be dropped off at rail stations. With anticipated modifications to bus transit service providing access to these rail stations, access within a zip code will become more convenient.

Table 2.3
PROPORTION OF UNIVERSITY EMPLOYEES PROXIMATE TO LIGHT RAIL

Year	½-Mile Proximity to Light Rail Station		½-Mile Proximity to Light Rail Station and 1-Mile Proximity to Commuter Rail Train Station		Zip Code adjacent to Light Rail Station		Zip Code adjacent to Light Rail and Commuter Rail Train Stations	
	Employees	Percent of Employees	Employees	Percent of Employees	Employees	Percent of Employees	Employees	Percent of Employees
Existing	844	3%	1,483	6%	6,223	24%	6,862	27%
2021 (light rail extended to Northgate)	1,383	5%	2,022	8%	12,132	47%	12,771	50%
2023 (light rail extended to Lynnwood, Federal Way, and Overlake)	1,913	7%	2,552	10%	14,850	58%	15,489	61%
2024 (light rail extended to Redmond and Federal Way)	1,973	8%	2,612	10%	15,107	59%	15,746	62%

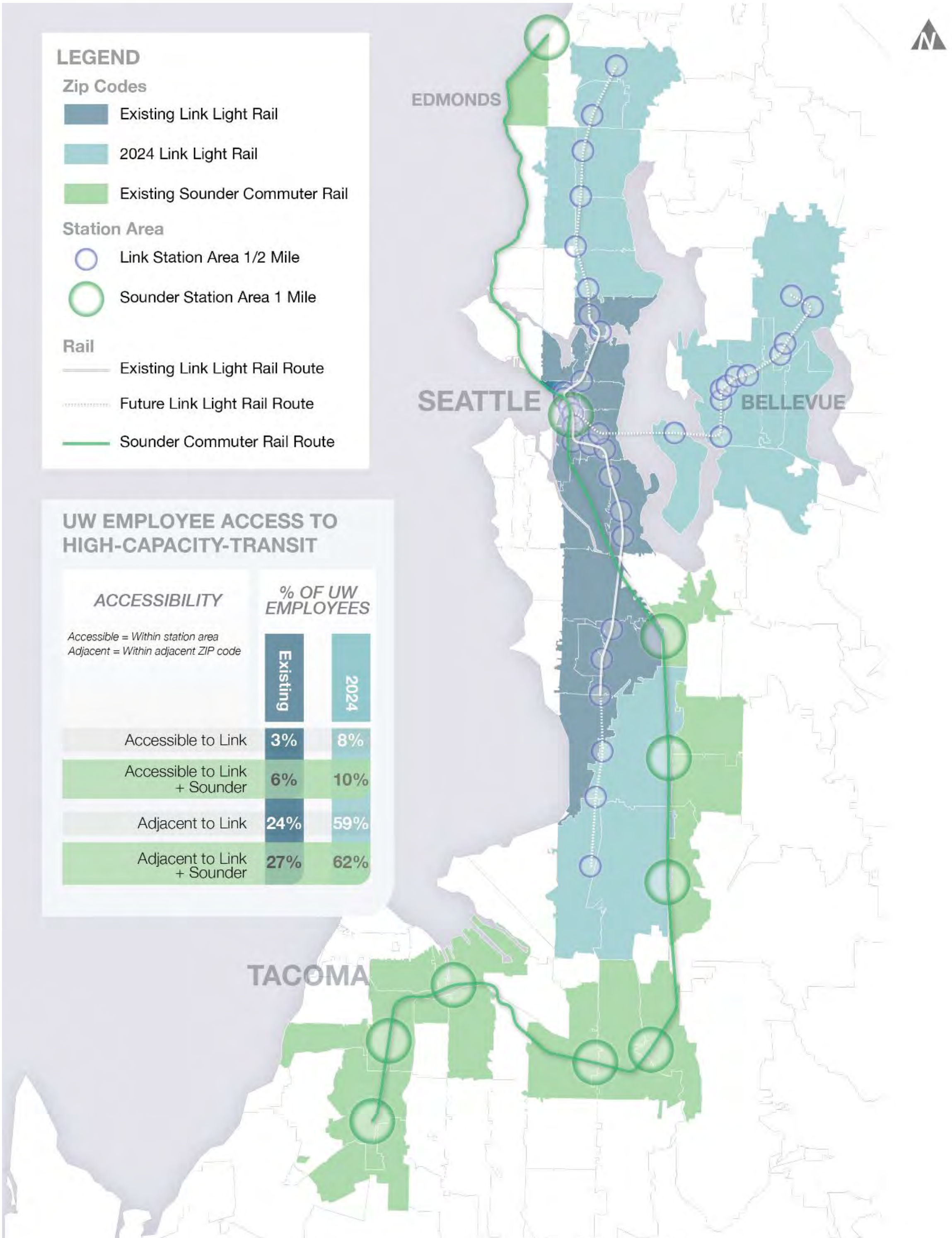
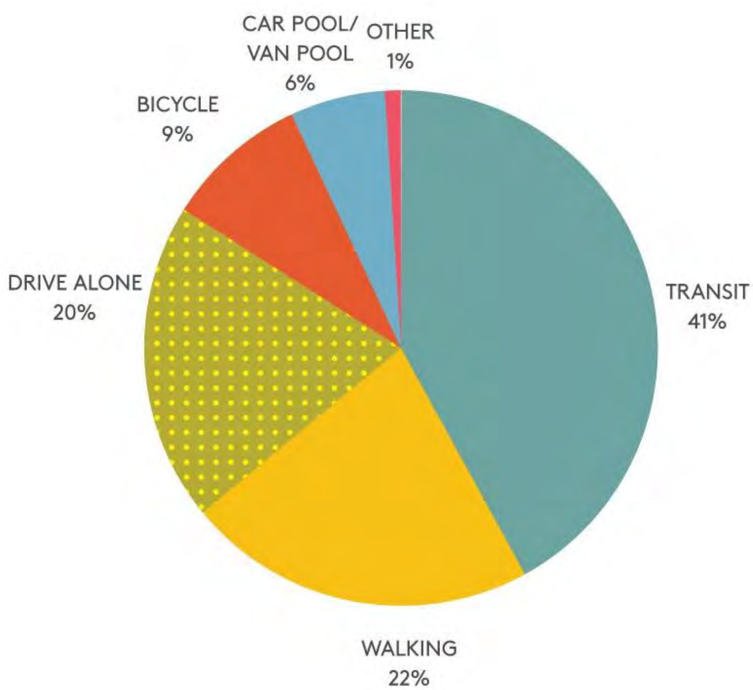


Figure 2.3 Employees Located in ZIP Codes within 1/2 Mile of Current and Future Light Rail and 1 Mile of Sounder Train

Other assumptions that support this transportation analysis are also discussed in greater detail in Appendix B Methods & Assumptions and include:

- **Peak Analysis Period** – Data collected from traffic counts at area intersections indicate that the highest demand for the study area is during the PM peak (as opposed to the AM peak) for most of the study area. This time coincides with the end of the work day for much of the University as well as people travelling through the area and the end of classes for many. As a result, the PM peak period was analyzed for all transportation operations.
- **Mode Split** – The mode split, or proportion of trips using a particular mode, is an important factor in evaluating the effects of growth. It is desirable to have students, faculty, and staff travel use lower impacting and more sustainable modes such as walking, biking, or taking transit. The University of Washington has a strong record of achieving an aggressive mode split, with drive-alone trips to the campus accounting for just 20 percent of all trips in 2015. This is significantly lower than other areas, employers, and communities in the region and has stayed near this percentage for several years. While mode split could fluctuate with the increased access to rail transit or other emerging trends, and indeed was surveyed in 2016 to have dropped to 17 percent, **for the purposes of this Transportation Discipline Report and EIS, mode split is assumed to remain a conservative 20 percent drive alone through 2028 for all alternatives**. However, the University has committed to a new SOV goal of 15% by 2028 in the 2018 Seattle CMP.



Source: University of Washington Transportation Services and Sasaki Architects, July 2017 CMP

Figure 2.4 Existing (2015) Travel Mode Split

- **Impact Analysis and Performance Measures** – Impact to transportation systems is generally assessed as a comparison between the No Action Alternative (with permitted development background growth) and each development alternative. As noted in Chapter 1, Introduction, the CMP development alternatives consist of up to 6 million square footage of additional development allocated to different sectors of the campus shown on Figure 1.7. Even though the amount of development is similar between development alternatives, the impacts may vary for transportation depending on where the development occurs. The City of Seattle has a variety of measurements for assessing impact, including screenlines as part of concurrency and the comprehensive plan. The performance measures used to evaluate transportation effects and impacts are described in Section 2.4., Performance Measures.

Screenline A hypothetical line where the aggregate of trips crossing the line is measured and compared.

- **Emerging Trends** – Table 2.4 summarizes trends and technologies that have been considered as emerging factors in this analysis; however, the impact and effects of these factors remains to be seen. The analysis was conducted applying what is known.

Table 2.4
EMERGING TRENDS AND TECHNOLOGY

Trend or Technology	Description
Changing Travel Behavior of Millennials	Changing travel behavior among millennials (defined as those reaching adulthood in the early 21st century) suggests this generation may be choosing alternatives to driving alone for travel. A study by the University of Michigan Transportation Research Institute indicates that driver licensing for teens and young adults is declining. For example, the number of 19-year-olds with drivers' licenses dropped from 87% in 1983 to 69% today.[2]
Smart Traffic Signal Technology	Traffic signal operations and control are being improved through better real time information, data fusion that improves understanding of travel patterns, and improved operations of traffic signals to better respond to actual traffic patterns and vehicle types. The City of Seattle owns, manages, and operates traffic signals around the City and would take the lead in implementing new adaptive signal control technology.
Shared Use Auto Mobility Ride-Hail and Transportation Network Companies	While rideshare programs through transportation network companies (TNCs) like Lyft and Uber and carshare programs like Car2Go, Zipcar, and ReachNow are popular and gaining in popularity, there are limited data related to these programs impact or effectiveness in reducing drive-alone behavior. Carshare is operated near the University campus, is available for student use, and is included in the Campus Transportation Management Plan as potential options to support commuting. Parking and passenger loading areas are available throughout the campus and will be assessed as needs arise.
Bikeshare	Pronto, a not-for-profit bikeshare system was implemented in 2015 with mixed success. The program, which included memberships for short- and long-term bicycle rental, ended in March 2017. The future of bikeshare is uncertain; however, there is interest in attempting to create a bikeshare program in the future as the bikeshare technology improves. Pronto stations were located at several locations within and near the campus. As a new bikeshare program evolves, the University would participate in locating and supporting that program.
Autonomous and Semi-Autonomous Vehicles	There are projections that in the next 20 years, autonomous vehicles may broadly replace the automobile fleet. Semi- autonomous vehicles are already on the market, assisting drivers and helping avoid crashes. In the future, these vehicles could be completely autonomous and potentially reduce congestion (vehicles are expected to operate safely with reduced distance between vehicles and potentially higher speeds). Autonomous vehicles have been proposed to operate cleanly (potentially electrically), for a variety of vehicle types—buses, trucks, and passenger vehicles—and potentially for shared use, thus further reducing the need for automobile ownership. As the technology evolves, autonomous vehicles may become part of the campus fleet to support mobility of people and goods. Additionally, space may be needed to accommodate drop-offs and storage.

[2] http://www.umtri.umich.edu/what-were-doing/news/more-americans-all-ages-spurning-drivers-licenses, 2016.

Other operational and policy changes – The City of Seattle and other agency partners are contemplating new policies, such as the establishment of Mobility Hubs, and service policies, such as advancing ending joint light rail and bus operations in the Downtown Seattle Transit Tunnel in 2018 as part of a planning effort called One Center City. These efforts are described below.

- **One Center City (OCC)** – In partnership with the Downtown Seattle Association, King County Metro, and Sound Transit, the City of Seattle is evaluating mobility options for the 10 City Center neighborhoods (https://www.seattle.gov/transportation/onecentercity.htm). As part of this study, the City and their partners are evaluating options for advancing the end of joint bus-light rail operations in the Downtown Seattle Transit Tunnel by fall of 2018. Ending joint operations had been planned to accommodate expansion of light rail service simultaneous with light rail extension to Northgate in 2021. Ending joint operations in 2018 would accommodate construction for rail to the eastside and the Convention Place station closure needed to support expansion of the Washington State Convention Center.

  Options being studied as part of ending joint tunnel operations include the rerouting of transit service from the Eastside (currently using SR 520 and bound for downtown) to the Link light rail University of Washington Station adjacent to Husky Stadium. This rerouting could increase transit passenger travel time and result in reduced ridership. Additionally, this rerouting could increase passenger and bus interactions around the light rail station, including adding up to six routes with an increase of over 40 buses during peak hours. It should be noted that this service concept represents a near-term option and would adapt and change to integrate with light rail station openings. The Metro transit service concept applied for the 2028 design horizon is expected to be similar to the 2025 METRO CONNECTS concept. As the City evaluates this option, the University will work with the City to evaluate impacts and potential solutions to ensure safe and efficient transit transfers.

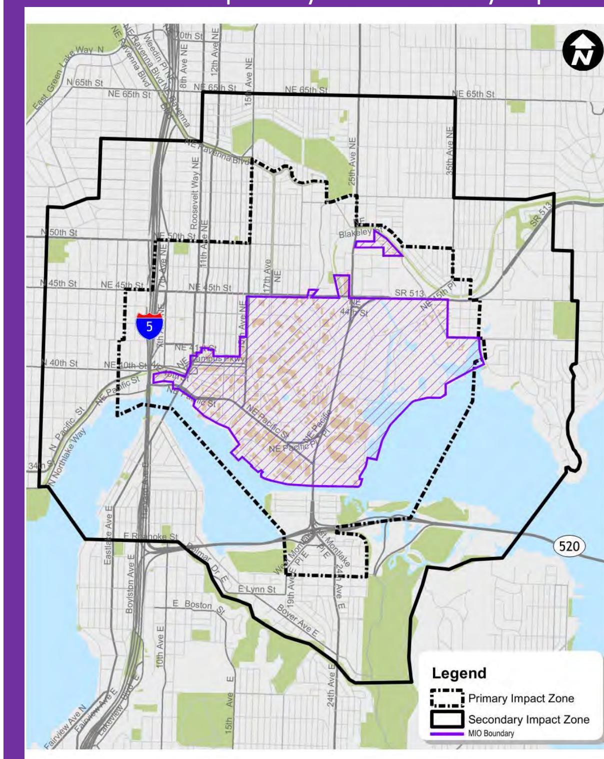
- **Mobility Hubs** – As part of the development of the One Center City multimodal planning effort, the City is exploring the development of Mobility Hubs, where planning for transportation modes is integrated to meet City objectives of reducing the proportion of drive alone trips and improve the efficiency of connecting people to transit. The City is in the process of establishing how these will function, what constitutes a hub, and how they will be developed and evaluated. The CMP is being developed to integrate transportation modes and provide connectivity across modes but does not identify "Mobility Hubs" until they are further defined (size, scale and requirements).

2.4 PERFORMANCE MEASURES

A variety of performance measures are used to analyze the effects and impacts of the proposed CMP alternatives. These performance measures are defined for the primary and secondary impact zones and apply to different transportation modes with different potential thresholds.

Primary and Secondary Impact Zones – As noted in Section 2.1, Study Area, the CUA identifies a primary and secondary impact zone to use for the purposes of analyzing impacts. The primary impact zone surrounds an area defined as the Major Institution Overlay (MIO). The impact zones suggest that impacts dissipate farther away from campus. It is expected that there will be greater impacts identified in the primary impact zone; therefore, more detailed analysis is conducted within this area. In the secondary impact zone, impacts are expected to dissipate and thus a more aggregate analysis is applied.

MIO (Major Institution Overlay): The Major Institution Overlay is a boundary defined by the City of Seattle Land Use and Zoning Code that notes the extents of the University of Washington Seattle campus. It is shown below (and larger as Figure 2.1) in reference to the primary and secondary impact zones



Thresholds – For some performance areas, there are defined and established measures of impact or thresholds, such as intersection operational analysis and parking utilization. Thresholds specific to the University of Washington are described in the CUA and include maximum allowable caps for vehicle trips to the University facilities (University cap), to University area facilities (U District cap), and University parking facilities (Parking cap) in the MIO. Where there are maximum allowable caps in specific areas, the thresholds are noted.

The performance measures applied in this Transportation Discipline Report are summarized in Table 2.5 and described in greater detail in Appendix B, Methods and Assumptions.

Table 2.5
PERFORMANCE MEASURES

Transportation Mode	Measure of Effectiveness	What it Measures?	Base Assumptions (see details in Appendix B)	Results
Pedestrian	Proportion of Development within 1/4 mile of multifamily housing	How likely are students, faculty, and staff able to live in proximity to the University campus and walk to school/work?	GIS mapping	Recently approved U District Upzoning means more multifamily housing opportunity in proximity to the University to support an improved job-housing balance within the U District and support high walk modes.
	Proportion of Development within 1/4 mile of University of Washington residence halls and multifamily housing available in the U District	How likely are students able to live in proximity to the University campus and walk to school?	GIS mapping	Current assumed campus residential is more multifamily housing in proximity to the University, which supports an improved job-housing balance within the U District and supports high walk modes.
	Quality of Pedestrian Environment	What is the quality of the walking environment inside and outside the campus area (secondary impact zone) and how will it change with growth?	Review of the existing conditions, Pedestrian Master Plan gaps, and visual / qualitative assessment of major pedestrian corridors in the secondary impact zone.	Qualitative analysis shows gaps from Mobility Plans that may impact connectivity in the secondary impact zone.

Transportation Mode	Measure of Effectiveness	What it Measures?	Base Assumptions (see details in Appendix B)	Results
	Pedestrian Screenline Demand and Capacity	Is there enough capacity for pedestrians to cross the roadways, including crosswalks and skybridges, around the edge of the campus to accommodate growth?	2016 pedestrian counts at all crossings. Include transit trips that start as pedestrian. Add background growth associated with Brooklyn Station. Pedestrians are apportioned by subarea growth. Maintain existing ped bridges. Transit Cooperative Research Methods 165.	There is adequate capacity for pedestrian growth to cross the arterial roadway edges within crosswalks at intersection, mid-block crosswalks, and sky bridges. Adequate capacity is available even without sky bridges.
	Pedestrian Transit Station/Stop Area LOS	Is there enough space at transit stop areas to accommodate growth in pedestrians and transit riders at transit stops/station areas?	Existing counts at busiest stops. Background growth of 12%. Stop area measurements from the field excluding walk ways. Methods in the Transit Cooperative Research Program 165.	Current transit stop areas are adequate to accommodate increased growth overall. Stops at NE Pacific Street/ 15th Avenue NE (under pedestrian bridge) and at NE 42nd Street/ 15th Avenue NE fall below LOS D with the addition of development-related growth. The stops could be expanded.

Transportation Mode	Measure of Effectiveness	What it Measures?	Base Assumptions (see details in Appendix B)	Results
Ped/ Bicycle	Burke-Gilman Trail Capacity	Is there adequate capacity along the Burke-Gilman Trail to accommodate background and campus growth in pedestrian and bicycle travel?	Burke-Gilman Study from 2011. Add projections and increase with background and CMP growth.	In 2011 the University completed a plan for the Burke-Gilman Trail defining the need for separated trails. With the separation, the trail meets future demand.
Bicycle	Bicycle Parking & Utilization	Is there adequate bicycle parking on campus to help encourage and meet the needs of those choosing bicycling now and into the future?	Current bicycle utilization.	Adequate capacity exists today with only 60-70% of available racks utilized. As new development occurs, the amount of bicycle racks will increase accordingly.
	Bikeshare Utilization and Distribution	How has bikeshare worked to promote alternative modes of transportation? How can future bikeshare serve to promote alternative modes?	Data was collected from Pronto on popular stations and routes within the area.	Pronto bikeshare ended in March 2017. Future plans for bikeshare are uncertain.

Transportation Mode	Measure of Effectiveness	What it Measures?	Base Assumptions (see details in Appendix B)	Results
	Quality of Bicycle Environment	What is the quality of the riding environment inside and outside the campus area (secondary impact zone) and how will it change with growth?	Review of the existing conditions and plans. Visual assessment of major pedestrian corridors in the secondary impact zone.	Qualitative analysis shows planned improvements provide additional connectivity where gaps are present today.
Transit	Proportion of Development within 1/4 mile of RapidRide routes	How likely are campus students, faculty, and staff in new developments able to be in proximity (within 1/4 mile) to new regional RapidRide transit corridors?	Anticipated development within a 1/4 mile distance (as the crow flies).	Most new development would be within 1/4 mile of RapidRide routes and stops
	Proportion of Development within 1/2 mile of Light Rail	How likely are campus students, faculty, and staff in new developments able to be in proximity (1/2 mile) to existing and proposed light rail stations?	Anticipated development within a 1/2 mile distance (as the crow flies) from Link stations.	Most new development would be within 1/2 mile of planned light rail stations.
	Transit Stop Capacity	How will growth in transit riders and planned service impact capacity at key	Counts at key stops. Physical features at stops and transit patron growth.	Current transit stops are adequate to accommodate anticipated transit volumes, with the

Transportation Mode	Measure of Effectiveness	What it Measures?	Base Assumptions (see details in Appendix B)	Results
		transit stops serving the campus?		exception of the NE Pacific St/15th Ave NE and NE 42nd St/15th Ave NE.
	Transit Travel Times and Delay	How would increased growth in transit passengers and vehicle traffic impact transit travel time?	Current transit speeds and speed differential between transit and vehicles and increased delays due to growth in transit patrons.	Transit travel speeds decrease with No Action and Action Alternatives development.
	Transit Loads at Screenlines	How would growth in transit riders impact ridership and transit loads on planned service?	Current transit patrons at key screenlines. Background growth. All CMP transit growth assigned to key transit stops.	University Way NE (the Ave) and 11th Ave NE transit loads may exceed capacity.
All Vehicles	Arterial Corridor Operations	How will growth in vehicle traffic impact key corridor travel speeds?	Volumes and Intersection data. Synchro delays and corridor travel times. Existing travel times.	Increases in travel times at some corridors.
	Intersection Operations	How will growth in vehicle traffic impact individual intersection operations?	Volumes and intersection data. Synchro intersection delays.	Some signalized and unsignalized intersections meet an impact criteria of 10% development trips, and poor LOS.
	Comprehensive Plan Screenline Volumes	How will growth in vehicle traffic impact estimated comprehensive plan screenlines?	Intersection and link volumes.	Comprehensive plan screenlines would not be exceeded.

Transportation Mode	Measure of Effectiveness	What it Measures?	Base Assumptions (see details in Appendix B)	Results
	Secondary Impact Zone Analysis	How will growth in vehicle traffic impact individual intersection volumes in the secondary impact zone?	assigned Intersection and turn movement volumes and signal timing. Background growth from travel demand model. Synchro delays. Alternatives to proposed parking facilities for growth for each alternative.	Intersection operations at seven key intersections within the secondary impact zone.
	University Cap[1]	How will growth in vehicle traffic impact the University trip cap?	Mode split 20% drive alone. Growth projections.	May exceed the AM cap in 2025; however, a lower mode split would not break the cap.
	U District Cap[1]	How will growth in vehicle traffic impact the U District trip cap?	Mode Split 20% drive alone. Growth projections.	May exceed the AM cap in 2025. A lower mode split would not break the cap as in prior result.
	Parking Supply & Utilization	How will growth in vehicle traffic and visitors impact parking for different growth scenarios? Are some parking areas overcapacity?	Campus-wide data from survey.	Overall utilization would not be exceeded.
	Parking Cap[1]	How will growth in vehicle traffic impact the parking cap?	Mode Split 20% drive alone.	Parking cap would not be exceeded.

Transportation Mode	Measure of Effectiveness	What it Measures?	Base Assumptions (see details in Appendix B)	Results
	Freight Corridor Impact	How will growth impact freight/services-related traffic?	Qualitative analysis on the anticipated impacts on freight routes.	Discussion of anticipated results

1. Caps as defined by the CUA agreement

Synchro 9 A software program that uses Highway Capacity Manual (HCM) methodology to evaluate intersection LOS and average vehicle delays.

Cordon A hypothetical boundary where trips are measured crossing in and or out of that boundary is measured and compared.

Level of Service (LOS) Traffic operations for an intersection or corridor can be described alphabetically with a range of LOS values (LOS A through F), with LOS A indicating free-flowing traffic and LOS F indicating extreme congestion and long vehicle delays. Intersection LOS incorporates intersection signal timing, signal phasing, channelization, traffic volumes, and pedestrian volumes for both signalized and unsignalized intersections, as applicable.

Intelligent Transportation Systems (ITS) Technology that can prioritize modes and reduce overall delay for vehicles as well as optimize to meet key objectives such as moving people (for example prioritizing higher occupancy vehicles).

3 AFFECTED ENVIRONMENT

This chapter describes the current transportation system that serves the University of Washington in Seattle. This system extends beyond the Major Institution Overlay (MIO) boundary and connects the students, faculty, staff, and visitors to homes and other destinations. Like many campuses, the University of Washington has a large resident student population living in dormitories or in housing within easy walking distance. As a major institution in a dense urban environment, the University of Washington relies on a well-developed, multi-modal transportation system to support mobility. This transportation system, described in this chapter, provides students, faculty, and staff access to a broad range of transportation choices—regional trails, bicycle facilities, light rail, frequent bus service, arterial streets, and close access to interstate and state highways—to name a few.

Major Institution Overlay (MIO): The Major Institution Overlay is a boundary defined by the City of Seattle Land Use and Zoning Code, noting the extents of the University of Washington.

For its part, the University has encouraged optimization of the transportation system by implementing a robust Transportation Management Plan that includes the U-PASS, and monitors utilization through annual surveys conducted by the University of Washington Transportation Services (UWTS). Transportation demand management and operation programs, including the U-PASS, enable the University to maintain an exceptionally low drive alone access mode, which results in a more efficient and sustainable use of the transportation system.

This chapter describes the transportation system currently used by the University population of students, faculty, and staff including parking of vehicles and bicycles. Because effects of growth on the transportation system are tied to the modes used, the proportion of the population using specific modes of travel is described in detail. Therefore, this chapter is organized by major modes of travel, consistent with the UWTS Mode Hierarchy triangle (Figure 3.1, right). Based on information found in the 2014 UWTS Climate Action Strategy for Transportation, mode hierarchy is determined from average emissions of travel modes. Travel modes with lower carbon emissions—including walk, bicycle, and telecommute modes—are shown at the top of the hierarchy, while higher-carbon travel modes such as driving alone are placed at the bottom of the hierarchy.

Figure 3.1 UWTS Mode Hierarchy Triangle
Source: UWTS Climate Action Strategies for Transportation, 2014

For each mode of access, a description of the system and how that system is used today, including demand, capacity, safety, and overall operations, follows.

3.1 EXISTING CAMPUS CHARACTERISTICS

As an institution in a densely populated city, the University of Washington's Seattle campus has flourished by relying on urban amenities, such as access to high-capacity transit, while also maintaining a pedestrian-focused setting within its core.

3.1.1 Mode of Access or Mode Split

A key element of this transportation analysis relies on mode of access, or how the students, faculty, and staff choose to travel to and within the MIO. The University of Washington supports various transportation choices so these populations have transit, rideshare, and non-vehicle transportation options. Mode choice is measured through an annual survey conducted by the University of Washington and by analyzing traffic counts. Current modes for campus populations include driving alone, carpooling, taking transit, walking, and riding bicycles. Student, faculty, and staff campus populations differ in the transportation modes they choose: students heavily favor pedestrian and transit modes; faculty and staff tend to drive alone or use transit. Over time, with the addition of the U-PASS program, non-single occupant vehicle (SOV) travel has increased for all population groups, while driving alone has declined. The mode split for the campus suggests that approximately 20 percent of the campus population travels by drive alone vehicles (based on 2015 survey data of modes). A recent survey for 2016 indicated that this drive alone number had dropped to 17 percent as more people opt to take transit. This new trend suggests that the opening of the Link light rail University of Washington Station in March 2016, is encouraging transit use. While the change is positive, the analysis presented in this report assumes a more conservative 20 percent drive alone mode split.

Table 3.1 provides a summary of the existing (2014) population in terms of headcount for students, faculty, and staff. These headcounts represent the most recently available data and are the basis for forecasting with future campus development Headcount or campus population for students, faculty and staff reflects the actual enrollments and employment for the campus. Surveys for the campus indicate that this headcount is higher than the number of actual trips that show up on campus each day due to the flexible schedules of students and faculty. Factoring down to reflect that students and faculty do not spend five days and 40 hours on campus each week was applied with the result being full-time equivalents. These full-time equivalents (FTEs) were used as the basis for evaluating parking. The FTE reduction is noted in Table 3.1. For the purposes of the transportation modal analysis, headcount was applied as it is more closely tied to anticipated growth projections.

Table 3.1
EXISTING (2014) UNIVERSITY POPULATION

Population	Headcount	FTE
Students	45,213	43,724
Faculty	7,951	7,107
Staff	17,333	16,324
Total Population	**70,497**	**67,155**

Source: Sasaki Architects, Inc., 2016

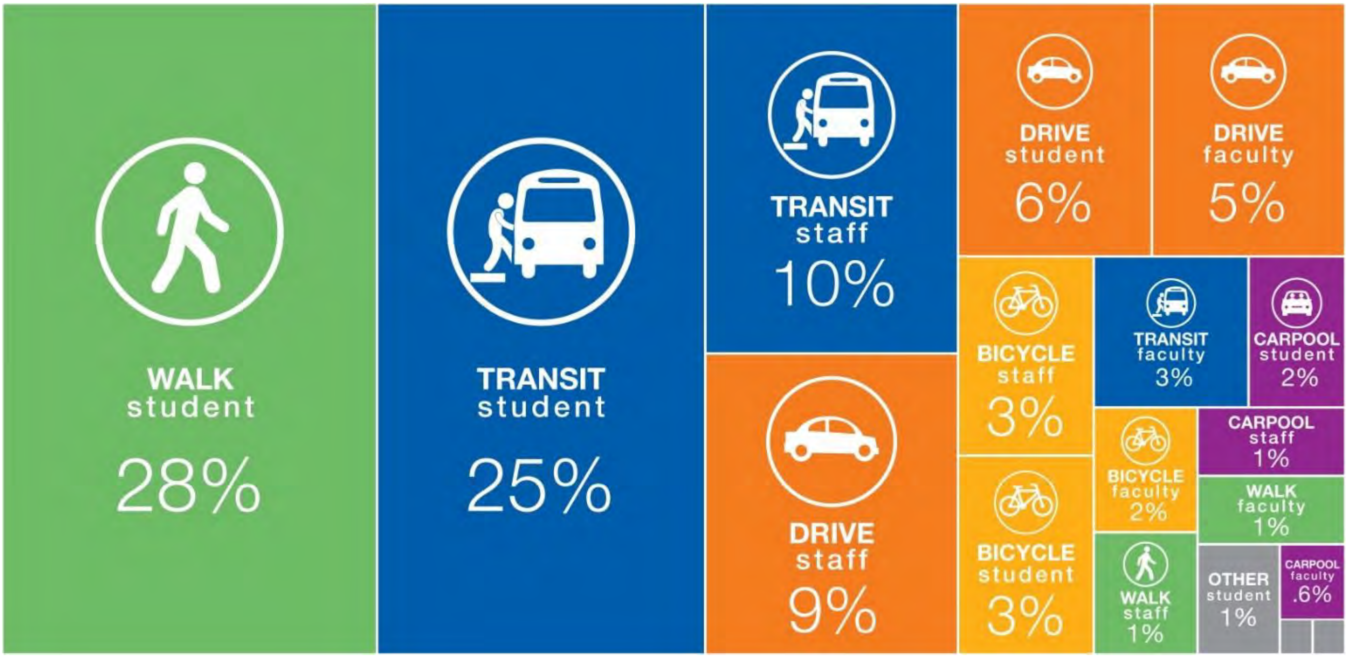
A summary of the existing 2014 headcount population by mode for each campus group (students, faculty, and staff) is provided in Table 3.2 below.

Table 3.2
EXISTING (2014) HEADCOUNT BY MODE (POPULATION)

Population	Drive Alone	Carpool	Transit	Walk	Bicycle	Other	TOTAL
Students	3,720	1,887	19,894	16,277	3,165	270	45,213
Faculty	3,539	583	1,988	557	1,113	171	7,951
Staff	5,683	1,966	7,280	693	1,300	411	17,333
Total Population	**12,942**	**4,436**	**29,162**	**17,527**	**5,578**	**852**	**70,497**

Source: Transpo Group, 2015

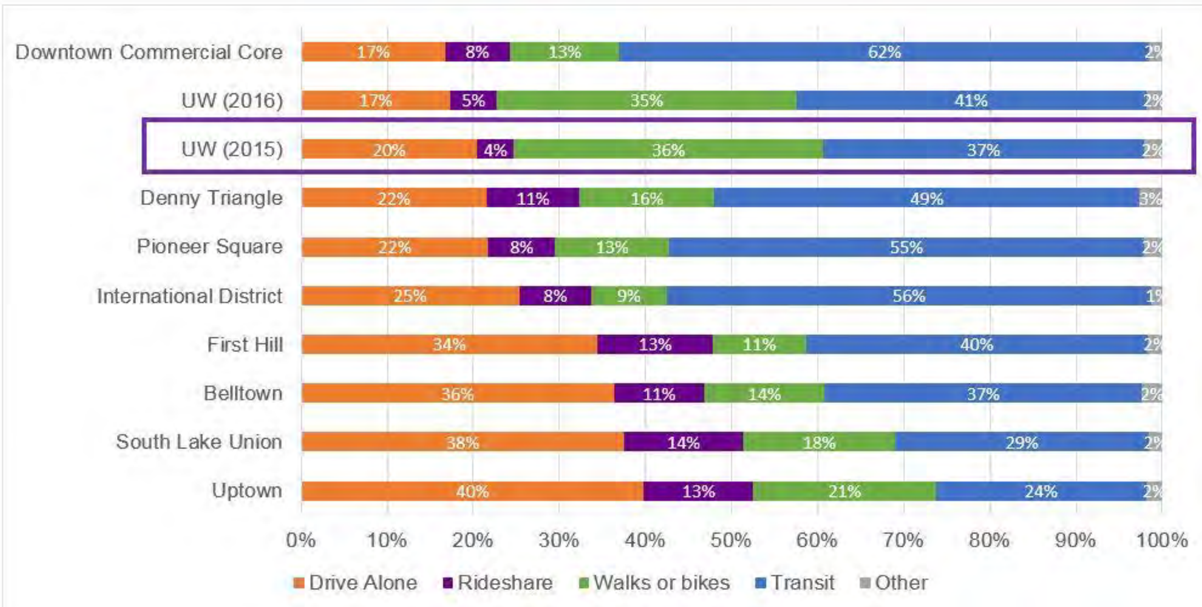
Another way to view mode choice for the whole campus is illustrated in Figure 3.2. The proportional graph shows the mode split survey from 2015 by mode for each population and reflects the high student population (as compared to faculty and staff). As shown in the graphic, considering all trips, over 50 percent of total campus trips are the student walk (28 percent of all trips) and student transit (25 percent of all trips). This pattern is likely due to the University of Washington's focused strategies in promoting lower impacting modes of travel.



Source: University of Washington Transportation Services, 2015 Survey, Transpo Group, 2016

Figure 3.2 2015 Total Campus Mode Choice Visual Representation

As compared to other City of Seattle neighborhoods, the University of Washington has one of the most successful programs for promoting modes other than drive alone. Figure 3.3 provides a comparison of the University of Washington mode splits to other City of Seattle neighborhoods. As shown, the campus operates with one of the lowest drive alone percentage as compared to these neighborhoods.



Source: Commute Seattle Center City Commuter Mode Split Survey, 2016 and University of Washington, 2016

Figure 3.3 Existing Neighborhood Mode Share Comparison

Such positive results in demand management can be credited, in part, to the implementation of the U-PASS. The University of Washington's U-PASS program subsidizes transit use by including a transit pass with a university member's Husky Card. Since its inception in 1991, the U-PASS has resulted in a substantial reduction in vehicle trips to and from campus. Also, the University has seen continued success in reducing SOV travel to the campus in subsequent years.

3.2 PEDESTRIANS

According to existing (2014) data, as shown in Table 3.2, a total of 17,527 people choose walking as their mode to access the University of Washington campus. Of these individuals, most (16,277) are students that live on or near campus, over 550 are faculty members, and almost 700 are staff. According to the 2015 University of Washington Transportation Study survey, just under one-third of trips accessing campus are walking trips.

3.2.1 Pedestrian Facilities

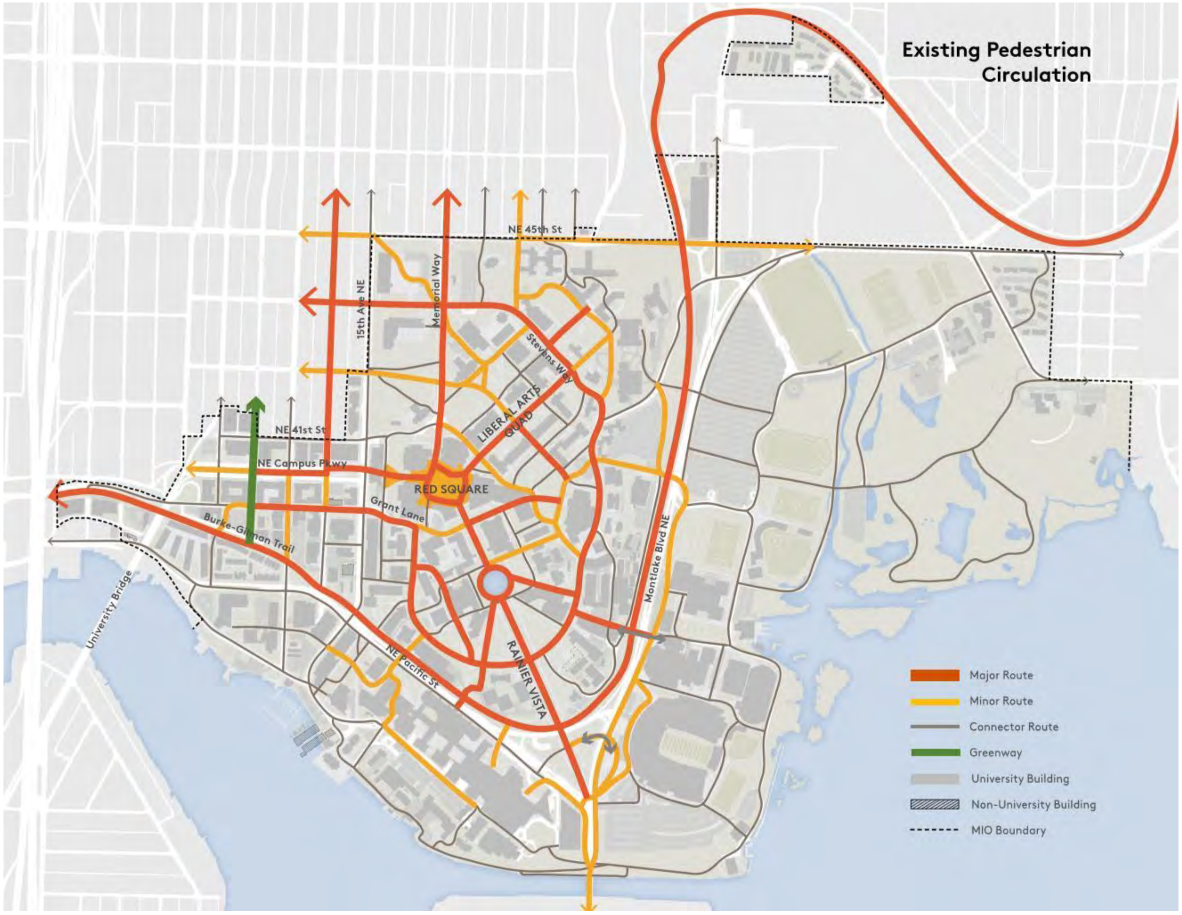
The system of pedestrian facilities serving the University of Washington consists of a network of pathways and sidewalks throughout campus. The pathways have been designated as **major** or **minor** in the Campus Master Plan (CMP). Major pathways for pedestrians include the Burke-Gilman Trail, Stevens Way, Memorial Way NE/17th Avenue NE, and NE Campus Parkway, as well as connecting pathways through Red Square, Rainier Vista, and the Quad, among others. The Burke-Gilman Trail—although under City of Seattle jurisdiction in other neighborhoods—is owned and maintained by the University of Washington within the MIO boundary. Minor pedestrian pathways function as connections between major routes, including pedestrian pathways between the Husky Union Building (HUB) and Drumheller Fountain, and sidewalks along 19th Avenue NE and in the vicinity of Husky Stadium, among others. New light rail stations are also a priority for pedestrian pathways to the campus.

Central Campus is separated from other subareas of the campus by a series of barriers including arterials 15th Ave NE, NE Pacific Street, and Montlake Boulevard NE, as well as topographical barriers for universal access. Some of these barriers are noted in Figure 3.4. The Draft Pedestrian Master Plan Update identifies locations within Seattle with missing sidewalks and with widely spaced crosswalks and safety concerns; however, no specific projects have been identified to correct these barriers at this time.

Pedestrian connectors function as sidewalks and pathways less traveled than major and minor routes. For example, sidewalks along 18th Avenue NE and pedestrian pathways along Snohomish Lane and Walla Walla Road are classified as pedestrian connectors. The general network of existing pedestrian facilities within the campus is shown in Figure 3.5. The pedestrian network outside the campus is also well developed and serves pedestrians commuting from nearby residential areas, generally north and west. Standard city sidewalks are provided along the major arterials in the area.

Source: Sasaki Architects, July 2017 CMP

Figure 3.4 Barriers and Existing Edge Conditions



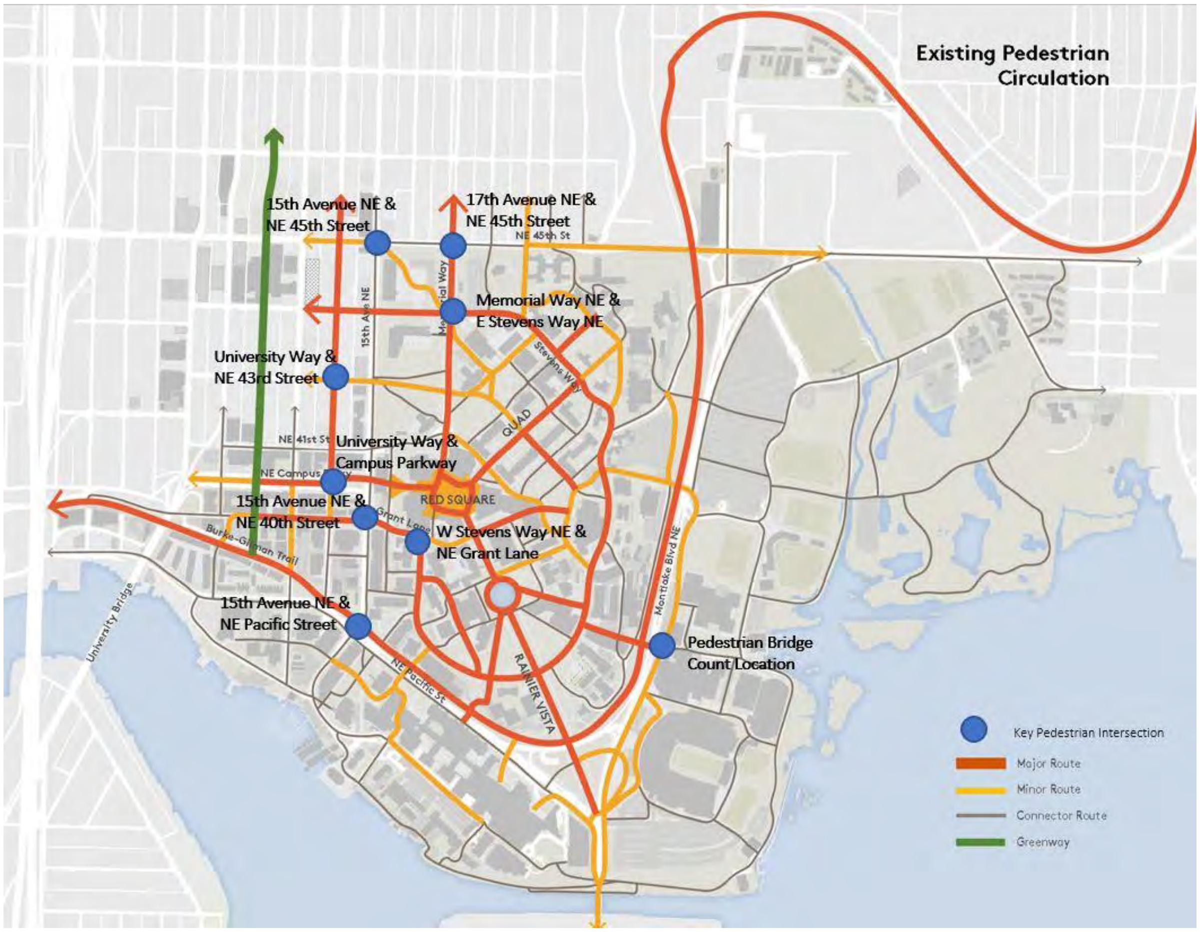
Source: Sasaki Architects, July 2017 CMP

Figure 3.5 Existing Pedestrian Facilities Classifications

Within the 1998 University Community Urban Center Plan, the City of Seattle designated NE 42nd Street, NE 43rd Street, and Brooklyn Avenue NE as neighborhood "Green Streets" to provide attractive and highly landscaped pedestrian routes in the University District (U District). In the spring of 2015, the City published a Green Streets Concept Plan further defining these routes. These designated streets enhance the pedestrian environment and will connect to the U District Station (Link light rail) that is currently under construction. Green Streets rely on partnerships with private development.

3.2.2 Pedestrian Counts

Figure 3.6 shows locations of key pedestrian intersections and reflects the extents of the areas of campus-related pedestrian trips and the CMP designations of major and minor pedestrian facilities. Based on high pedestrian counts, several intersections are noted as major pedestrian routes along one or both approaches. In the fall of 2016, a campus-wide count of pedestrians crossings at intersections and pedestrian bridges was conducted during the PM peak period prior to a major event (September 30th football game versus Stanford)



Source: Transpo Group, 2015

Figure 3.6 Key Pedestrian Intersections

Table 3.3 summarizes pedestrian volumes for each of the intersections highlighted above during the existing (2015) weekday PM peak hour. It should be noted that the 15th Avenue NE/ NE 40th Street/ NE Grant Lane intersection includes an all-walk pedestrian phase, with a walk phase for all pedestrian approaches occurring simultaneously.

Table 3.3
EXISTING (2015) WEEKDAY PM PEAK HOUR PEDESTRIAN VOLUMES AT KEY INTERSECTIONS

Intersection	Northbound Approach Crossings	Southbound Approach Crossings	Eastbound Approach Crossings	Westbound Approach Crossings
University Way / NE 43rd Street	240	140	550	470
University Way / Campus Parkway (West)	440	850	650	490
Memorial Way NE / E Stevens Way NE	440	80	300	170
W Stevens Way NE / NE Grant Lane	0[1]	710	0[1]	370
15th Avenue NE / NE 45th Street	270	300	200	160
15th Avenue NE / NE 40th Street / NE Grant Lane	970	490	110	120
15th Avenue NE / NE Pacific Street	260	80	120	160
17th Avenue NE / NE 45th Street	150	170	260	350

1. Construction activity closed segments of Stevens Way resulting in 0 pedestrian counts.

Source: Transpo Group, 2015

With the opening of the University of Washington Station in March 2016 near Husky Stadium, a new pedestrian bridge was constructed over Montlake Boulevard that included installation of a pedestrian/bicycle counter.

Pedestrian counts were also taken throughout the campus at all crosswalks and pedestrian bridges on September 30, 2016 during the PM peak period when there was a University of Washington football game. This period reflects a peak, saturation condition and a maturation of use for the light rail station. These counts also helped compare actual (video-taped counts) to automated counts on the NE Pacific Place pedestrian crossing that estimates pedestrian and bike counts.

The counts in 2015 and 2016 provide an opportunity to compare pedestrian counts prior to and after the opening of the University of Washington light rail station and also to compare volumes on days with and without events. The pedestrian bridge connecting the University of Washington light rail station to the campus opened in spring 2016 includes pedestrian and bicycle counting equipment. A same-day comparison of video counts of pedestrians and bicycles using the bridge to data from the counting equipment indicate that the automated counters may be undercounting by approximately 50 percent.

Pedestrian Bridges and Connection Points

Sky bridges and connection points provide pedestrian access from Central Campus to the other campus sectors. Existing pedestrian bridges provide grade-separated access with no vehicle conflicts over the arterials surrounding the campus. Across Montlake Boulevard, pedestrian bridges are located at NE Pacific Place, Snohomish Lane N (also known as Hec Ed), Wahkiakum Road, and the E1 parking area. The steep terrain from the central campus to the East sector and high speed, high volume Montlake Boulevard (State Route 513), pose barriers for pedestrians. These bridges provide unimpeded, safe, and more direct access to Husky Stadium, Alaska Airlines Arena, and other University of Washington athletic facilities, as well as the University of Washington Station. Pedestrian routes between campus and University Village, the

Center for Urban Horticulture, and neighborhoods east of Montlake Boulevard use these pedestrian bridges. All of these bridges are maintained by the University of Washington with the exception of the Snohomish Lane bridge (also known as Hec Ed), which is owned and operated by the City of Seattle Across NE Pacific Street, pedestrian bridges at the T-Wing and Hitchcock overpasses connect the campus and Burke-Gilman Trail with the University of Washington Medical Center.

Table 3.4 provides a summary of weekday PM peak hour counts on these facilities.

Table 3.4
EXISTING (2016) EVENT PM PEAK HOUR PEDESTRIAN VOLUMES AT PEDESTRIAN BRIDGES

Pedestrian Crossing Location	Crossing Roadway	PM Peak Hour Volume	Percent of Total Volume
E-1 Pedestrian Bridge	Montlake Boulevard	682	5%
Wahkiakum Road Pedestrian Bridge	Montlake Boulevard	3,724	27%
Snohomish Lane Pedestrian Bridge (at Alaska Airlines Arena) or "Hec Ed" bridge	Montlake Boulevard	2,938	21%
NE Pacific Place Pedestrian Bridge (at University of Washington Station)	Montlake Boulevard	4,198	30%
T-Wing Overpass Pedestrian Bridge	NE Pacific Street	264	2%
Hitchcock Overpass Pedestrian Bridge	NE Pacific Street	243	2%
Campus Parkway Pedestrian Bridge	15th Avenue NE	1,770	13%
Total PM Peak Hour Volume		**13,819**	**100%**

Source: Transpo Group, September 2016

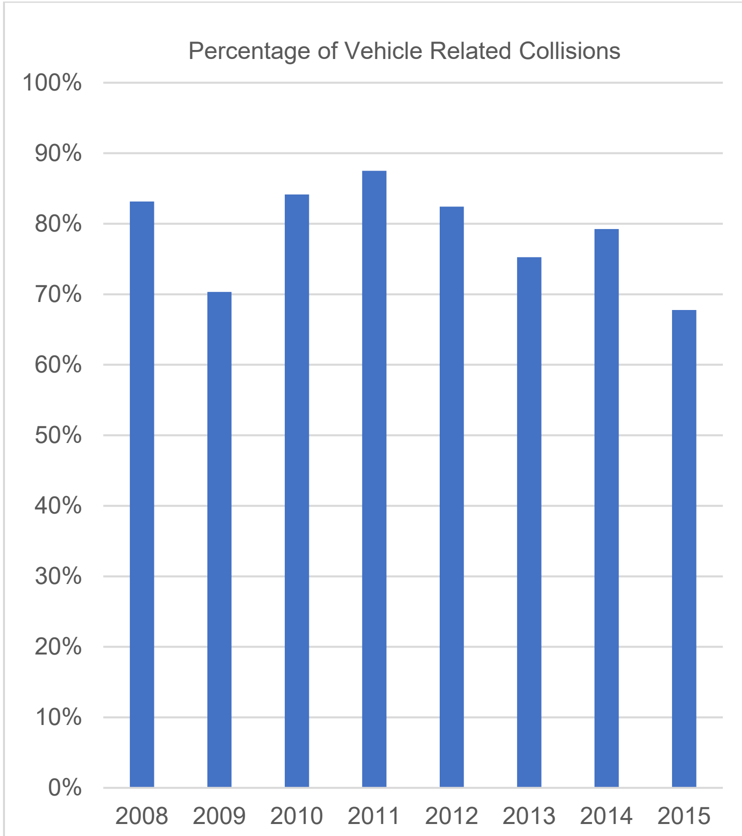
Aside from these connections, there is only one signal-controlled mid-block at-grade crossing of NE Pacific Street for pedestrians. Across 15th Avenue NE there is one pedestrian bridge at approximately Campus Parkway connecting Red Square and the Henry Art Gallery with Schmitz Hall. Other at-grade crossings of 15th Avenue occur at signal-controlled intersections at Pacific/ Burke-Gilman Trail, mid-block south of NE 40th Street, NE 40th Street/Stevens Way, NE 42st Street, NE 42nd Street, NE 43rd Street, and NE 45th Street.

Pedestrian and bicycle volumes were collected at the pedestrian overpass location above Montlake Boulevard NE, which connects the Burke-Gilman Trail with the E1 parking area in the East Campus sector. Data were collected in 15-minute intervals over one day in May 2016, from 7 am to 7 pm, at the east and west sides of the pedestrian bridge. From this data, a peak hour of 4:30 pm to 5:30 pm was determined, with a maximum of about 220 hourly pedestrian crossings (Transpo Group 2016).

3.2.3 Pedestrian Collision Data

Pedestrian and Bicycle Collisions

Based on data provided by UWTS, pedestrian and bicycle collisions are largely vehicle-related. Figure 3.7 below shows the percentage of vehicle-related collisions with pedestrians and bicycles from 2008 to 2015 in and around campus.

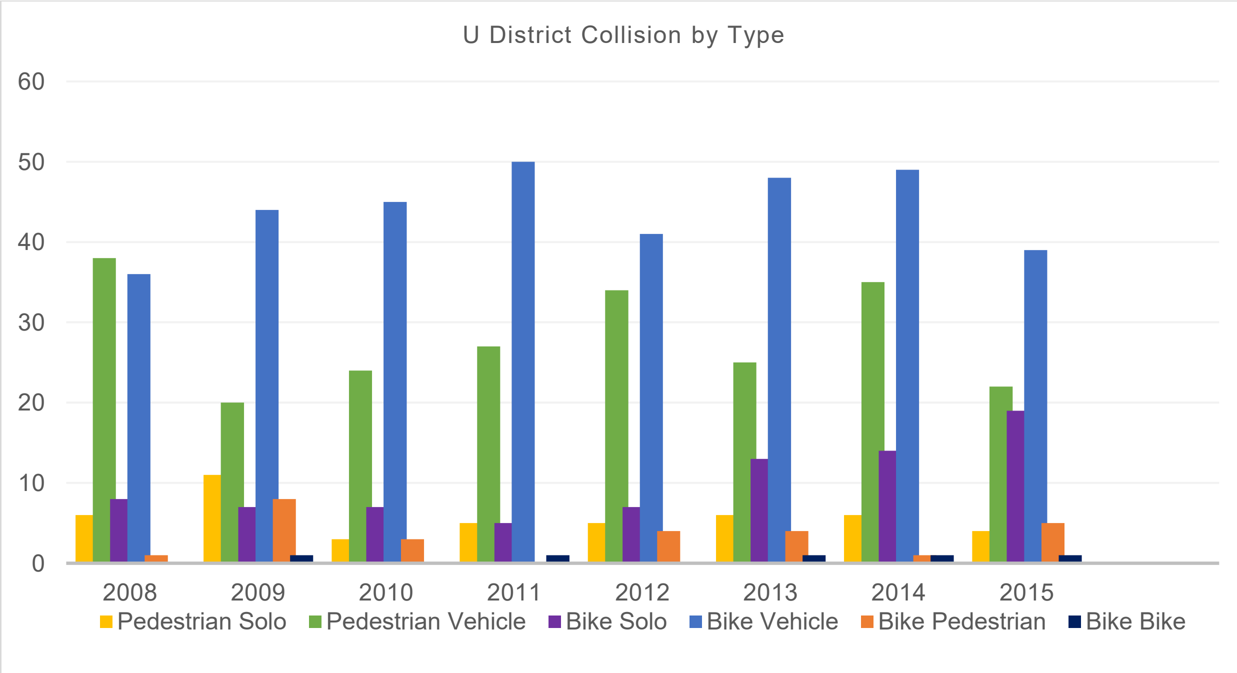


Source: UWTS

Figure 3.7 Historic Percentage of Vehicle-Related Pedestrian/Bicycle Collisions (Campus)

The same data is shown in more detail in Figure 3.8, which groups annual pedestrian and bicycle collisions by type. Between 2008 and 2015, pedestrian-vehicle and bicycle-vehicle collisions combined comprised the majority of all annual collisions involving pedestrians or bicycles, ranging from 82 to 106 collisions per year. Of these, on average, vehicles were involved in 79 percent of reported pedestrian and bicycle collisions.

The City of Seattle also collects collision data. Through an evaluation of Washington State Department of Transportation (WSDOT) and Seattle Department of Transportation (SDOT) information, there were 49 collisions that involved pedestrians, which averages to 16 per year for this eight-year period. Of the pedestrian collisions, four were reported at the Brooklyn Avenue NE/NE 50th Street, Roosevelt Way NE/NE 45th Street, and 11th Avenue NE/NE 45th Street intersections, and six were reported at the Brooklyn Avenue NE/NE 45th Street intersection. Continued focus on pedestrian safety by implementing both the Pedestrian Master Plan and Vision Zero will continue to improve these conditions.



Source: UWTS

Figure 3.8 U District Pedestrian-Bicycle Collisions by Type

A map of pedestrian and bicycle collisions is shown and described in further detail in Section 3.3.4, Bicycle Collision Data.

3.2.4 Performance Measures

Pedestrian performance measures have been developed to assess and compare alternatives. These measures assess impacts to pedestrian travel throughout the study area including the MIO, primary impact zone, and secondary impact zone. They are a mixture of quantitative and qualitative measures and are listed below and described in more detail throughout this section.

- Proportion of Development within 1/4 Mile of Multifamily Housing
- Proportion of Development within 1/4 Mile of University of Washington Residence Halls
- Quality of Pedestrian Environment
- Burke-Gilman Trail Capacity
- Pedestrian Screenline Demand and Capacity
- Pedestrian Transit Station/Stop Area LOS

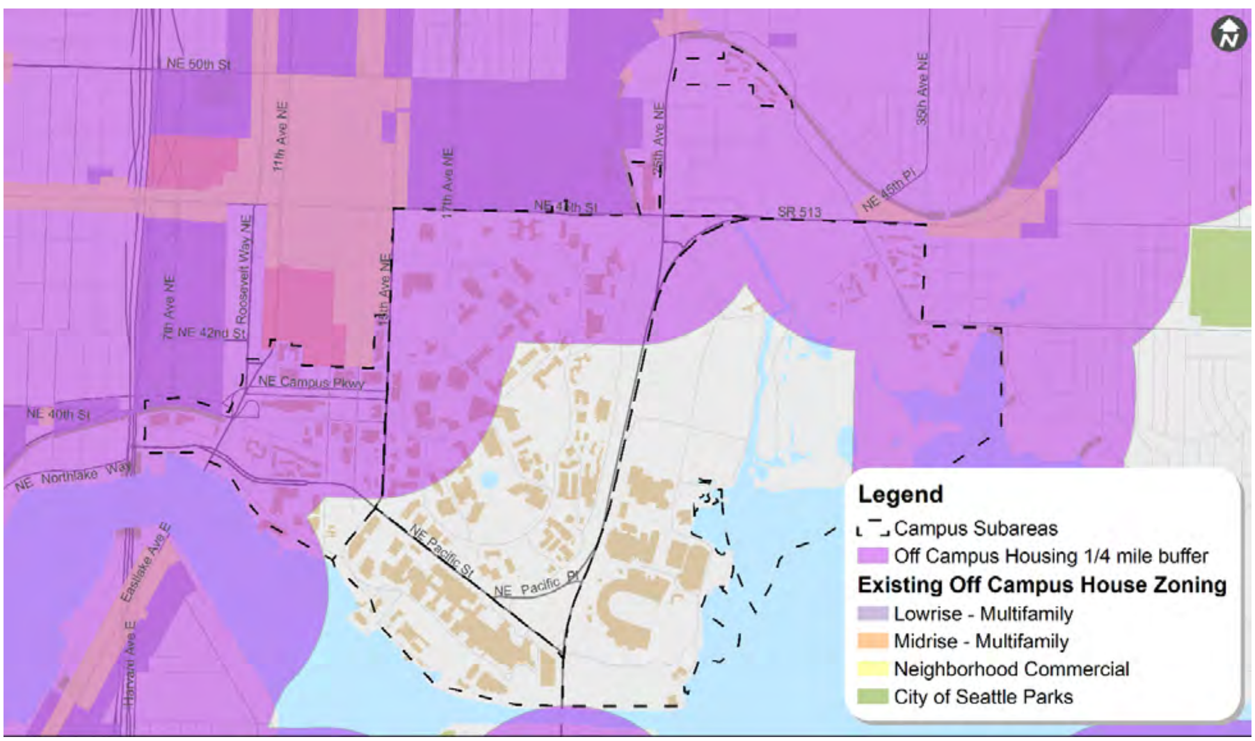
These measures reflect the effectiveness of the pedestrian network in providing safe, comfortable, and easy access to pedestrian destinations. Specifically, they should include housing to maintain a high walk mode choice on campus among students. For this analysis, each alternative was assessed based on future conditions of the pedestrian network and the effects of growth.

Proportion of Development Within 1/4 Mile of Multifamily Housing

Walking makes up over 30 percent of all existing campus-related trips. Proximity of campus development to housing is therefore one important measure to assessing the propensity of people to walk. This measure assesses the proximity of the current campus buildings and development to nearby multifamily housing. The measure determines the proportion of each sector within a 1/4 mile walk of areas currently zoned by the City of Seattle for multifamily housing (including lowrise, midrise, highrise, and neighborhood commercial developments). Of the current 16.8 million gross square footage of campus development, roughly 63 percent is within 1/4 mile of multifamily housing. Percentages for each area are shown in Table 3.5 and Figure 3.9.

Table 3.5
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF MULTIFAMILY HOUSING

Sector	Existing
West	80%
South	0%
Central	44%
East	69%
Average	**63%**

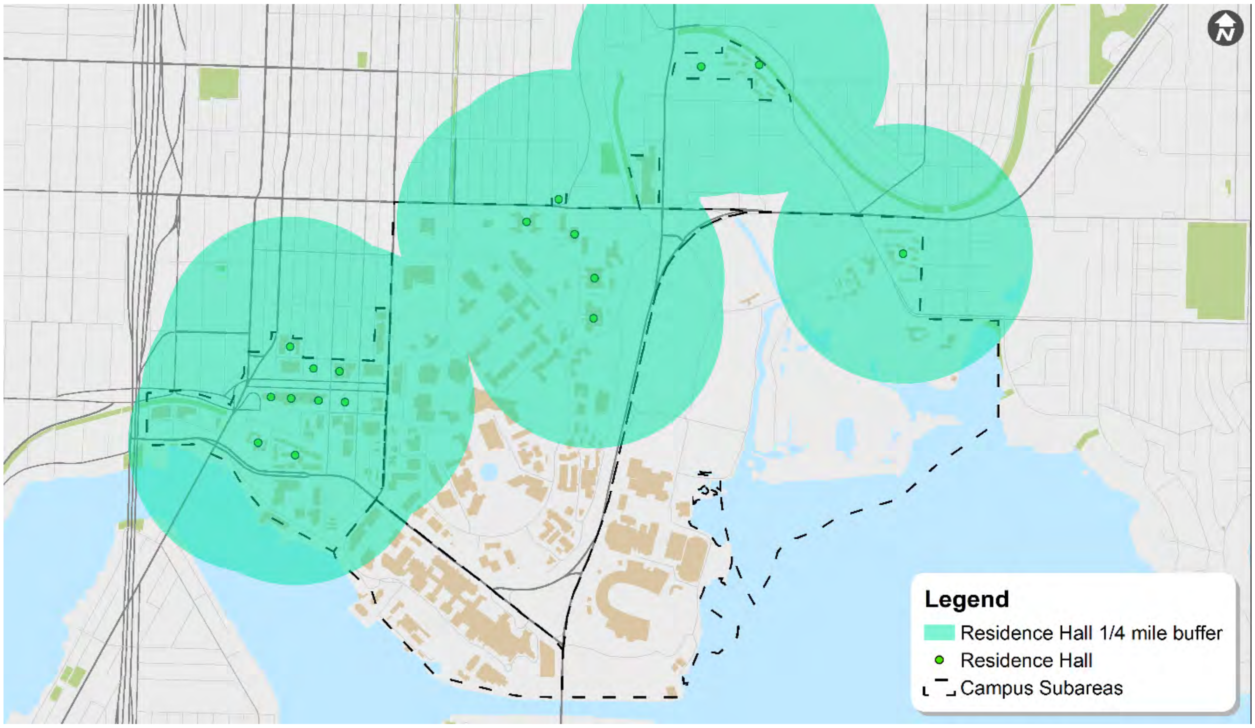


Source: Transpo Group, 2016

Figure 3.9 Proportion of Development within 1/4 Mile of Multifamily Housing

Proportion of Development Within 1/4 Mile of University of Washington Residence Halls

This performance measure assesses the proportion of campus development within walking distance of residence halls. Specifically, University of Washington residence halls were identified and then buffered by 1/4 mile, as shown in Figure 3.10 below. The percentage of each sector covered by this buffer was then used to scale an "average" percentage of development that might be expected to be within the 1/4 mile buffer. Notably, areas outside this buffer include athletic facilities and the University of Washington Medical Center.



Source: Transpo Group, 2016

Figure 3.10 Proportion of Development within 1/4 Mile of Residence Halls

Of the current 16.8 million gross square footage of campus development, roughly 76 percent is within 1/4 mile of residence halls. Percentages for each sector are shown in Table 3.6 below.

Table 3.6
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RESIDENCE HALLS

Sector	Existing
West	80%
South	11%
Central	60%
East	80%
Average	**76%**

Quality of Pedestrian Environment

This measure determines the quality of the pedestrian environment within the primary and secondary impact zones. The assessment draws from the City of Seattle Draft Pedestrian Master Plan and others, such as the University District Green Streets Plan and the SR 520 Bridge Replacement and HOV Project, when specific projects are identified. While other measures focus on pedestrian volumes in locations where capacity limitations may exist, this measure more generally addresses where pedestrian travel might be expected to change.

Currently, the quality of the pedestrian environment varies throughout the impact zones. Within the MIO, and particularly on Central Campus, pedestrian travel is well accommodated with a connected and generally high-quality pedestrian network.

Pedestrian Bridges

Pedestrian barriers surrounding Central Campus, such as Montlake Avenue NE and NE Pacific Street, are accommodated by a number of pedestrian bridges. Along 15th Avenue NE and NE 45th Street, at-grade crossings and one pedestrian bridge provide access to campus. Travel for people with limited mobility is more disconnected due to grade changes; however, mobility is specifically addressed through a holistic approach including a Dial-A-Ride shuttle system and others.

A new pedestrian and bicycle bridge near the University of Washington Station improves connectivity from campus to light rail, the Montlake Bridge, and areas to the south. Improvements to pedestrian facilities across major barriers such as I-5 and the Montlake Cut have been identified.

Sidewalk Facilities

Within the U District, pedestrians travel along a dense, regular street grid providing good connectivity with sidewalks on both sides in most areas. Sidewalk facilities in the district are generally older, which is reflected in both their design and worn condition. Pedestrian demand is higher along University Way, NE 45th Street, Campus Parkway, and a number of other streets with dense housing or other features. Pedestrian improvements along Roosevelt Way, NE 42st Street, and NE 43nd Street have been identified.

Specifically, the City of Seattle Pedestrian Master Plan (Updated April 2017) has identified several locations as having missing sidewalk connections within the Pedestrian Priority Investment Network, a list of long-term priorities in pedestrian infrastructure.

Within the primary impact zone, the following locations are missing all or portions of their sidewalk connections:

- The north side of NE Pacific Street, between 15th Avenue NE and NE Pacific Place.
- NE 45th Street, between 22nd Avenue NE and Montlake Boulevard NE, along the northern portion of the roadway.
- Both NE 40th Street and 5th Avenue NE are missing pedestrian connections intermittently along the roadways.
- Parts of Lake Washington Boulevard E
- Additional local roads south of the Montlake Bridge.

Extending to the secondary impact zone, the following locations are missing connection features:

- Connections are missing south of the Cheshiahud Lake Union Loop, such as Harvard Avenue E, Fairview Avenue E, and Franklin Avenue E.

- East of University Village, portions of Union Bay Place NE, NE Blakely Street, 35th Avenue NE, and Princeton Avenue NE are missing sidewalks.

Neighborhood Greenways

Currently, the U District has two Neighborhood Greenways that are intended to prioritize cycling and walking. The existing Neighborhood Greenway within the primary impact zone is located on 12th Avenue NE, extending north from NE Campus Parkway. This pathway provides a north/south connection through the study area. In the secondary impact zone, a Neighborhood Greenway exists on 40th Avenue NE, east of the primary impact zone. This connection extends north of the Burke-Gilman Trail.

Safety

As described previously, an average of 16 collisions involving pedestrians occurred per year during the eight-year period of 2008–2015. Of those 16 pedestrian collisions, the majority were reported at the following intersections:

- 11th Avenue NE/ NE 45th Street
- Brooklyn Avenue NE/ NE 50th Street
- Brooklyn Avenue NE/ NE 45th Street
- Roosevelt Way NE/ NE 45th Street

More detailed pedestrian collision analysis is found in Section 3.2.3, Pedestrian Collision Data.

Pedestrian Screenline Demand and Capacity

This performance measure determines the adequacy of current crossings in accommodating future background growth and anticipated growth from the master plan. Peak hour demand, capacity, and level of service (LOS) were measured at all at- and above-grade (sky bridge) crossing locations along the edge of the Central Campus. The screenline locations were Montlake Boulevard NE, NE Pacific Street, 15th Avenue NE, and NE 45th Street. The following sections summarize pedestrian screenline volumes within the affected environment.

Screenline: An imaginary line across which the number of passing vehicles is counted.
Level of Service: Level of service or quality of service is a qualitative measure of how well a facility operates. Quantitatively it is often defined as a comparison of demand to theoretical capacity. An illustration is provided below.

Existing Data

Existing (2016) pedestrian screenline volumes were based on counts conducted at locations shown in Figure 3.11 during the PM peak period on Friday, September 30, 2016. These counts represented a peak pedestrian demand, capturing the congestion generated from the 5:30 pm University of Washington V. Stanford football game on that date. All pedestrian crossing locations were evaluated at the screenlines as shown in Figure 3.11 and listed in Table 3.7 and include at-grade crosswalks and grade-separated bridges. All pedestrian crossings were aggregated into four screenlines: Montlake Boulevard NE, NE Pacific Street, 15th Avenue NE, and NE 45th Street.

FINAL

Figure 3.11 Pedestrian Screenline Capacity Analysis Study Area

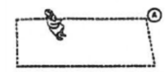
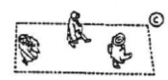
Table 3.7
STUDY AREA PEDESTRIAN CROSSING LOCATIONS

Screenline	Crossing Location	Crossing Type	Campus Sector
Montlake Boulevard NE	Pend Oreille Road NE/ NE 44th Street	North approach leg	East
	Pend Oreille Road NE/ NE 44th Street	South approach leg	East
	E-1 Lot Pedestrian Bridge	Above-grade pedestrian bridge	East
	IMA Pedestrian Bridge	Above-grade pedestrian bridge	East
	Hec Edmundson Pedestrian Bridge	Above-grade pedestrian bridge	East
	Husky Stadium Pedestrian Bridge	Above-grade pedestrian bridge	East
	NE Pacific Street	North approach leg	South
	NE Pacific Street	South approach leg	South
NE Pacific Street	Montlake Boulevard NE	East approach leg	South
	Montlake Boulevard NE	West approach leg	South
	UWMC Access	East approach leg	South
	UWMC Access	West approach leg	South
	UWMC East Pedestrian Bridge	Above-grade pedestrian bridge	South
	UWMC mid-block crossing	At-grade mid-block crossing	South
	UWMC West Pedestrian Bridge	Above-grade pedestrian bridge	South
	15th Avenue NE	East approach leg	South
	15th Avenue NE	West approach leg	South
15th Avenue NE	NE Pacific Street	North approach leg	South
	NE Pacific Street	South approach leg	South
	15th Avenue mid-block crossing	At-grade mid-block crossing	West
	NE 40th Street/ Stevens Way NE	North approach leg	West
	NE 40th Street/ Stevens Way NE	South approach leg	West
	Campus Parkway Pedestrian Bridge	Above-grade pedestrian bridge	West
	NE 41st Street	North approach leg	West
	NE 41st Street	South approach leg	West
	NE 42nd Street	North approach leg	West
	NE 42nd Street	South approach leg	West

Screenline	Crossing Location	Crossing Type	Campus Sector
	NE 43rd Street	North approach leg	West
	NE 43rd Street	South approach leg	West
	NE 45th Street	North approach leg	West
	NE 45th Street	South approach leg	West
NE 45th Street	15th Avenue NE	East approach leg	West
	15th Avenue NE	West approach leg	West
	17th Avenue NE	East approach leg	Central
	17th Avenue NE	West approach leg	Central
	18th Avenue NE	East approach leg	Central
	18th Avenue NE	West approach leg	Central
	19th Avenue NE	East approach leg	Central
	19th Avenue NE	West approach leg	Central
	20th Avenue NE	East approach leg	Central
	20th Avenue NE	West approach leg	Central

Pedestrian walkway capacity at all screenline crossings was determined from the Walkway LOS, as stated in the Transit Cooperative Highway Research Program (TCRP) Report 165: Transit Capacity and Quality of Service Manual, 3rd Edition. Capacity was calculated for each crossing location and aggregated by screenline using the pedestrian space and walk speed metrics shown in Table 3.8 to determine the crossing level of service (LOS). Based on the metrics shown in Table 3.8, each screenline is assigned a letter grade A to F where LOS A represents low density of people in the crosswalk and LOS F represents a high density of people in the cross walk. Capacity at LOS E, as shown in Table 3.9, was assumed to be maximum saturation flow or a theoretical capacity.

Table 3.8
PEDESTRIAN WALKWAY LEVEL OF SERVICE

LOS	Pedestrian Space (ft^2/person)	Average Speed (ft/min)	Walkway Characteristics	Illustration
A	≥ 35	260	Walking speeds freely selected; conflicts with other pedestrians unlikely.	
B	25–35	250	Walking speeds freely selected; pedestrians respond to presence of others.	
C	15–25	240	Walking speeds freely selected; passing is possible in unidirectional streams; minor conflicts for reverse or cross movement.	
D	10–15	225	Freedom to select walking speed and pass others is restricted; high probability of conflicts for reverse or cross movements.	
E	5–10	150	Walking speeds and passing ability are restricted for all pedestrians; forward movement is possible only by shuffling; reverse or cross movements are possible only with extreme difficulty; volumes approach limit of walking capacity.	
F	< 5	< 150	Walking speeds are severely restricted; frequent, unavoidable contact with others; reverse or cross movements are virtually impossible; flow is sporadic and unstable.	

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition; Highway Capacity Manual

Table 3.9
MAXIMUM PEDESTRIAN CAPACITY BY SCREENLINE

Screenline	Maximum Capacity (People/hour at LOS E)
Montlake Boulevard NE	102,345
NE Pacific Street	67,326
15th Avenue NE	58,104
NE 45th Street	24,366

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition

Additional field characteristics used to determine capacity for each pedestrian crossing included crossing area, walk time, and flash-don't-walk time where applicable. A combined walk and flash-don't-walk time per hour was determined for each crossing location. Unsignalized mid-block crossings and pedestrian bridges were assumed to be unconstrained for the hour.

Existing pedestrian crossing volumes were determined from the September 2016 counts. A scaling factor was applied to crossing locations closest to Husky Stadium, accounting for the high volume of pedestrians generated by the evening football game. The scaling factor was developed from the differences between the PM peak hour pedestrian counts and WSDOT's automatic counter data at the Husky Stadium pedestrian bridge adjacent to the University of Washington Station. Existing scaled peak hour pedestrian volumes summarized by screenline are shown in Table 3.10.

Table 3.10
EXISTING (2016) PEAK HOUR PEDESTRIAN VOLUME AND LEVEL OF SERVICE

Screenline	Pedestrian Volume (People/ hour)	Level of Service
Montlake Boulevard NE	12,742	A
NE Pacific Street	3,252	A
15th Avenue NE	7,866	A
NE 45th Street	2,051	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition

As shown in Table 3.10, the existing (2016) peak hour aggregate pedestrian volumes for all screenlines operated at LOS A indicating that there is available capacity at crosswalks.

Pedestrian Transit Station/Stop Area LOS

The transit stop space analysis for pedestrians evaluates the peak hour demand, capacity, and LOS at key transit stops along Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE. Ten stops were identified that reflect the higher level of stop activity based on passenger count data from transit agencies.

The following sections summarize the pedestrian space per person and LOS at these locations within the affected environment.

Existing Data

Existing pedestrian space was measured in square footage per person at 10 key transit stops in the study area, as shown in Figure 3.12 and listed in Table 3.11. Existing data is based on counts and field observations conducted during the PM peak hour on Tuesday, January 31, 2017. Pedestrian counts at each transit stop were collected via a two-hour video recording at each location, during the PM peak hour of 4 pm to 6 pm. Video data were summarized to determine the 15-minute period with the greatest number of pedestrians (the peak 15-minute pedestrian count) waiting at each transit stop analyzed. Field observations were conducted on Monday, January 30, 2017. Field data recorded the measurements of obstacles that may have impeded pedestrian waiting areas. Obstacles that were considered included pedestrian walkway space, trees, garbage cans, fire hydrants, and other objects that may have impacted the available waiting area. For analysis, the area occupied by obstacles was removed from the total area at each transit stop location. The effective area represented the remaining available space utilized by waiting transit riders. However, the effective area of each transit stop location excludes space for circulation and walkways; these areas are summarized in Table 3.11.

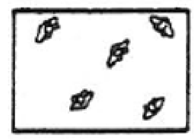
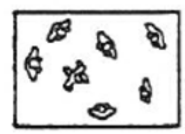
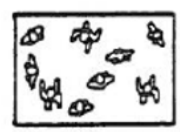
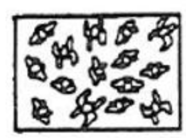
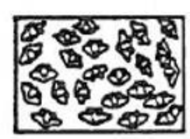
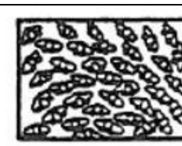
Figure 3.12 Pedestrian Transit Stop Space Analysis Study Area

Table 3.11
STUDY AREA TRANSIT STOP LOCATIONS

Stop ID Number	King County Metro Stop Number	Roadway	Stop Location	Description	Campus Sector	Effective Area (ft^2)
1	29,247	Montlake Boulevard NE	NE Pacific Street	Bay 1, south side of NE Pacific Street	South	1,930
2	29,405	Montlake Boulevard NE	NE Pacific Street	Bay 2, south side of NE Pacific Street	South	1,930
3	29,240	NE Pacific Street	Mid-block	North side of NE Pacific Street, under pedestrian bridge	South	315
4	29,440	15th Avenue NE	NE Campus Parkway	East side of 15th Avenue NE, north of Stevens Way NE	West	2,625
5	11,352	15th Avenue NE	NE 42nd Street	East side of 15th Avenue NE, north of NE 42nd Street	West	235
6	10,912	15th Avenue NE	NE 43rd Street	West side of 15th Avenue NE, south of NE 43rd Street	West	2,534
7	25,240	Montlake Boulevard NE	NE Pacific Place	Bay 4, east side of Montlake Boulevard, adjacent to Husky Stadium	East	1,072
8	25,765	Montlake Boulevard NE	NE Pacific Place	Bay 3, west side of Montlake Boulevard	East	2,990
9	75,410	Stevens Way NE	Pend Oreille Road	East side of Stevens Way NE	East	564
10	75,403	Stevens Way NE	Benton Lane	West side of Stevens Way NE, adjacent to the Husky Union Building	East	1,122

Pedestrian queuing capacity at each transit stop was determined from the Waiting Area LOS, as stated in the Transit Cooperative Highway Research Program (TCRP) Report 165: Transit Capacity and Quality of Service Manual, 3rd Edition. Capacity at LOS A to F was calculated for each crossing location and aggregated by campus sector using the pedestrian space metric shown in Table 3.12. Pedestrian space was calculated using the peak 15-minute pedestrian count and effective area at each location. Effective area was assumed to be constant throughout existing and future analysis years.

Table 3.12
PEDESTRIAN QUEUING AREA LEVEL OF SERVICE

LOS	Pedestrian Space (ft^2/person)	Queuing Area Characteristics	Illustration
A	≥ 13	Standing and free circulation through the queuing area is possible without disturbing others in the queue.	
B	10–13	Standing and partially restricted circulation to avoid disturbing others in the queue is possible.	
C	7–10	Standing and restricted circulation through the queuing area by disturbing others is possible; this density is within the range of personal comfort.	
D	3–7	Standing without touching is impossible; circulation is severely restricted within the queue and forward movement is only possible as a group; long-term waiting at this density is discomforting.	
E	2–3	Standing in physical contact with others is unavoidable; circulation within the queue is not possible; queueing at this density can only be sustained for a short period without serious discomfort.	
F	< 2	Virtually all personal within the queue are standing in direct physical contact with others; this density is extremely discomforting; no movement is possible within the queue; the potential for pushing and panic exists.	

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition; Highway Capacity Manual

Pedestrian space and LOS was determined at each location based on the PM peak pedestrian count and effective area as described above. Existing pedestrian space and LOS at each transit stop is summarized in Table 3.13. Note that the existing (2016) peak hour pedestrian space for all transit stop locations is at LOS C or better.

Table 3.13
EXISTING (2016) PEAK HOUR PEDESTRIAN SPACE AND LEVEL OF SERVICE

Stop Location	Stop ID Number	King County Metro Stop Number	Campus Sector	Pedestrian Space (ft^2/person)	Level of Service
NE Pacific Street Bay 1	1	29,247	South	49	A
NE Pacific Street Bay 2	2	29,405	South	43	A
NE Pacific Street at 15th Avenue NE	3	29,240	South	8	C
15th Avenue NE at Campus Parkway	4	29,440	West	109	A
15th Avenue NE at NE 42nd Street	5	11,352	West	88	A
15th Avenue NE at NE 43rd Street	6	10,912	West	49	A
Montlake Boulevard Bay 4	7	25,240	East	43	A
Montlake Boulevard Bay 3	8	25,765	East	120	A
Stevens Way NE at Pend Oreille Road	9	75,410	East	21	A
Stevens Way NE at Benton Lane	10	75,403	East	40	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition

3.3 BICYCLES

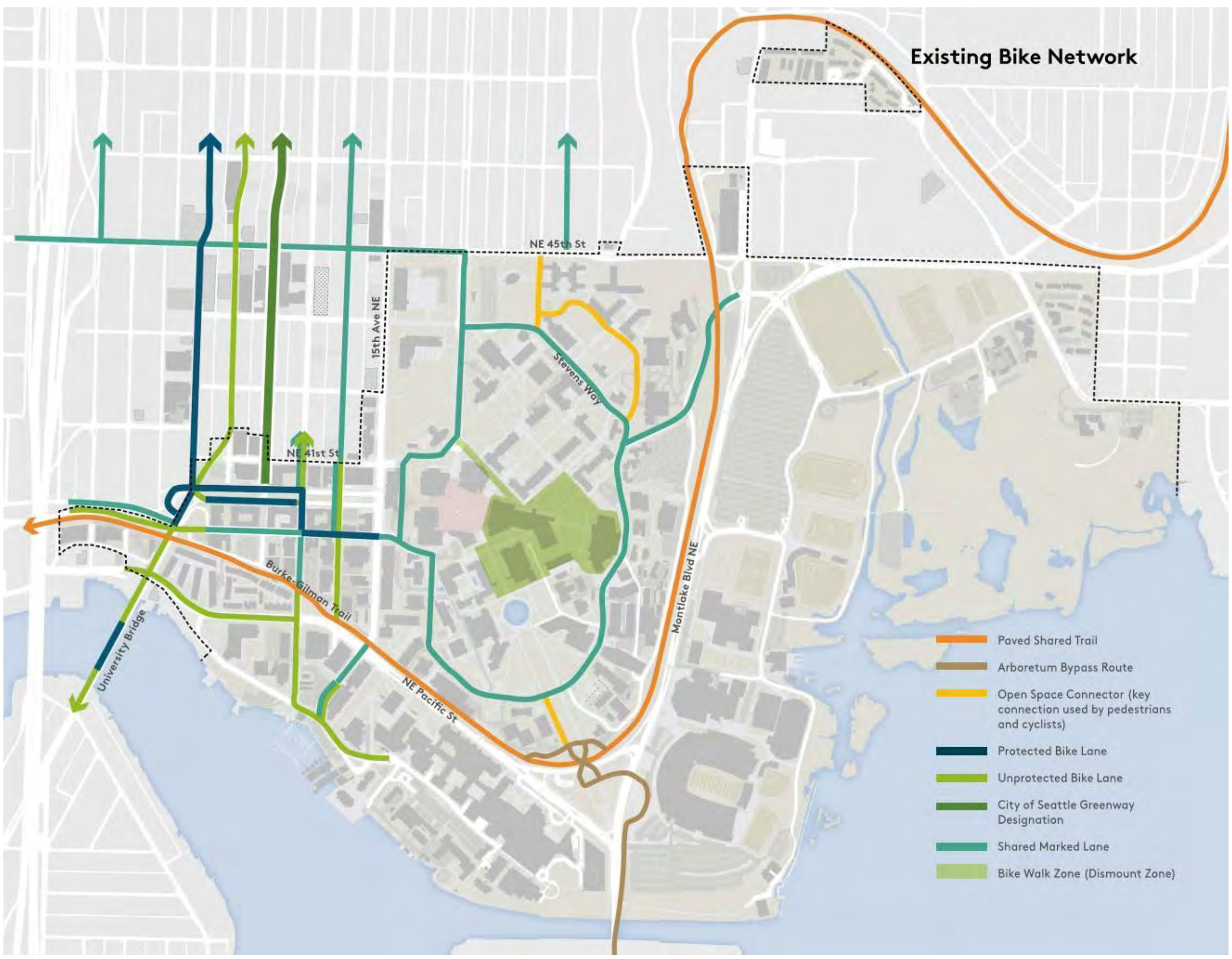
Within the campus community, approximately 5,600 individuals choose to bicycle to the University of Washington campus based on mode share data shown in Table 3.2. Most (over 3,100) are students. Faculty and staff combined that choose to bicycle to the campus total approximately 2,400.

3.3.1 Bicycle Facilities

The existing University of Washington bicycle system includes designated streets and pathways as well as end-of-trip facilities such as short-term bicycle parking, secured and covered bicycle parking, and shower/changing facilities.

Protected Bicycle Lane (PBL): A protected bicycle lane separates bicycles from pedestrians and vehicles on a roadway, creating safe and inviting facilities for people riding bikes of all ages and abilities.

Figure 3.13 shows the existing bicycle network near or serving the campus, including protected and unprotected bicycle lanes, shared lanes, greenways, and trails. Northeast Campus Parkway, NE 40th Street, and Roosevelt Way NE offer protected bicycle lanes, while 11th Avenue NE, parts of Brooklyn Avenue NE, and parts of University Way NE provide unprotected bicycle lanes. Stevens Way NE, Pend Oreille Road NE, and NE 45th Street have shared marked lanes for bicycle riders, and the Burke-Gilman Trail provides a paved, flat route for riders traveling throughout campus.



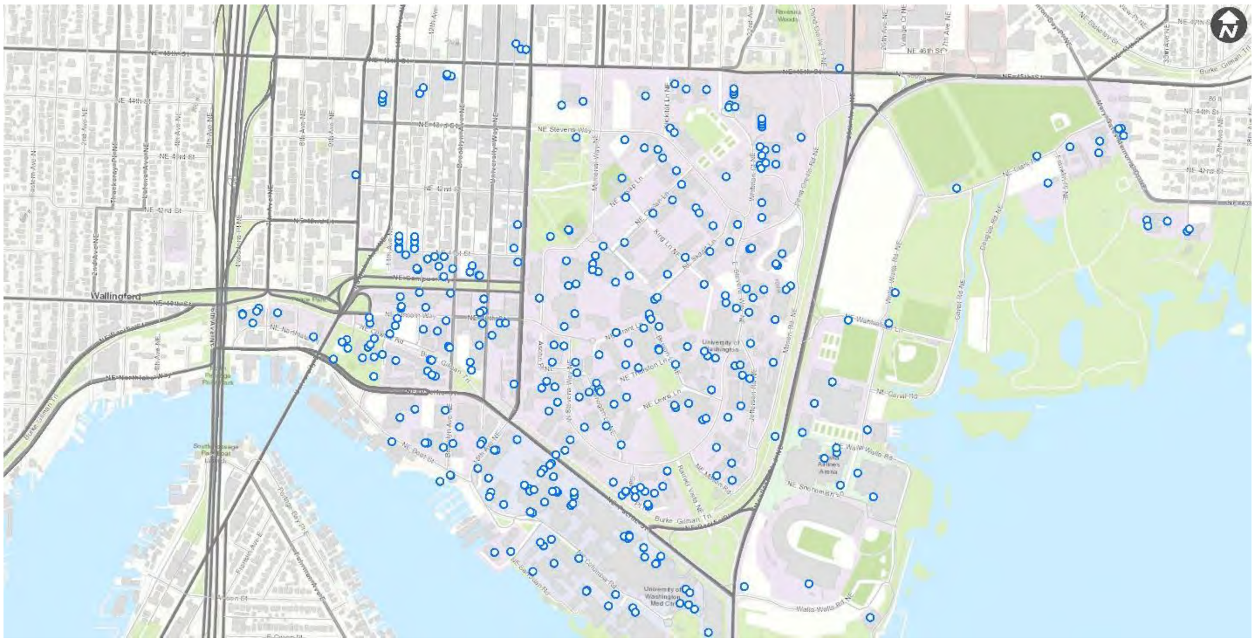
Source: Sasaki Architects, July 2017 CMP

Figure 3.13 Existing (2015) Bicycle Facilities

3.3.2 Bicycle Parking and Bikeshare Facilities

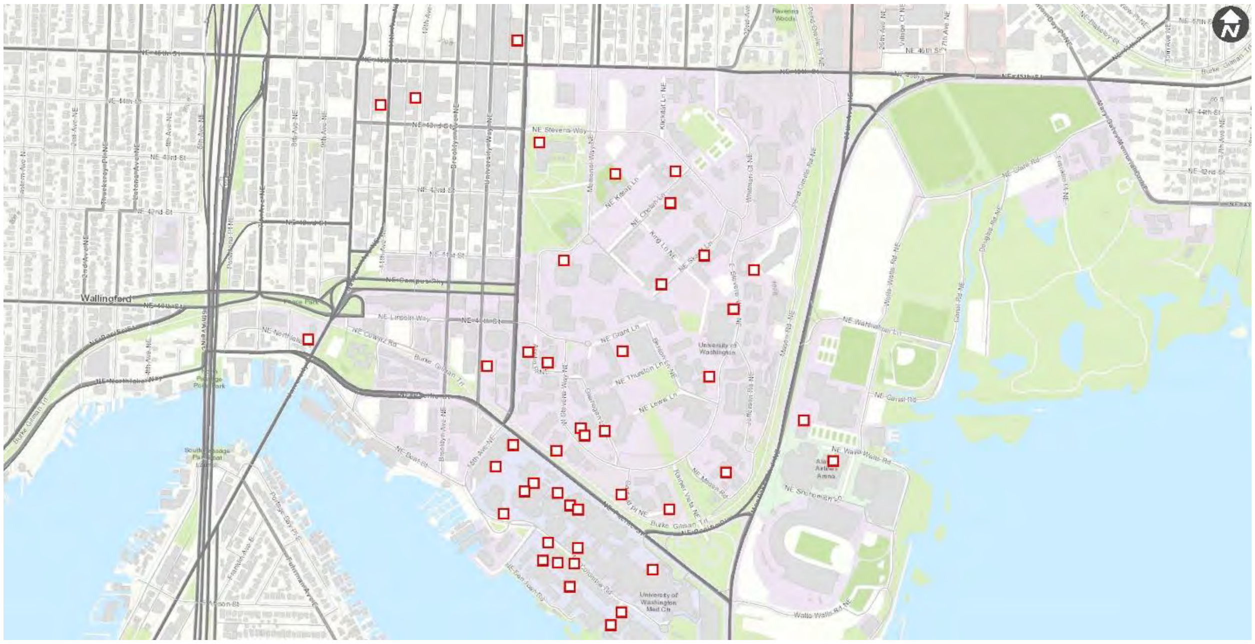
Bicycle Parking

Bicycle parking supply and accessibility provides an additional opportunity to support and encourage bicycle travel throughout the campus network. Existing (2016) bicycle rack locations and secure bicycle houses and lockers are shown in Figure 3.14 and Figure 3.15, respectively.



Source: University of Washington Transportation Services, 2016

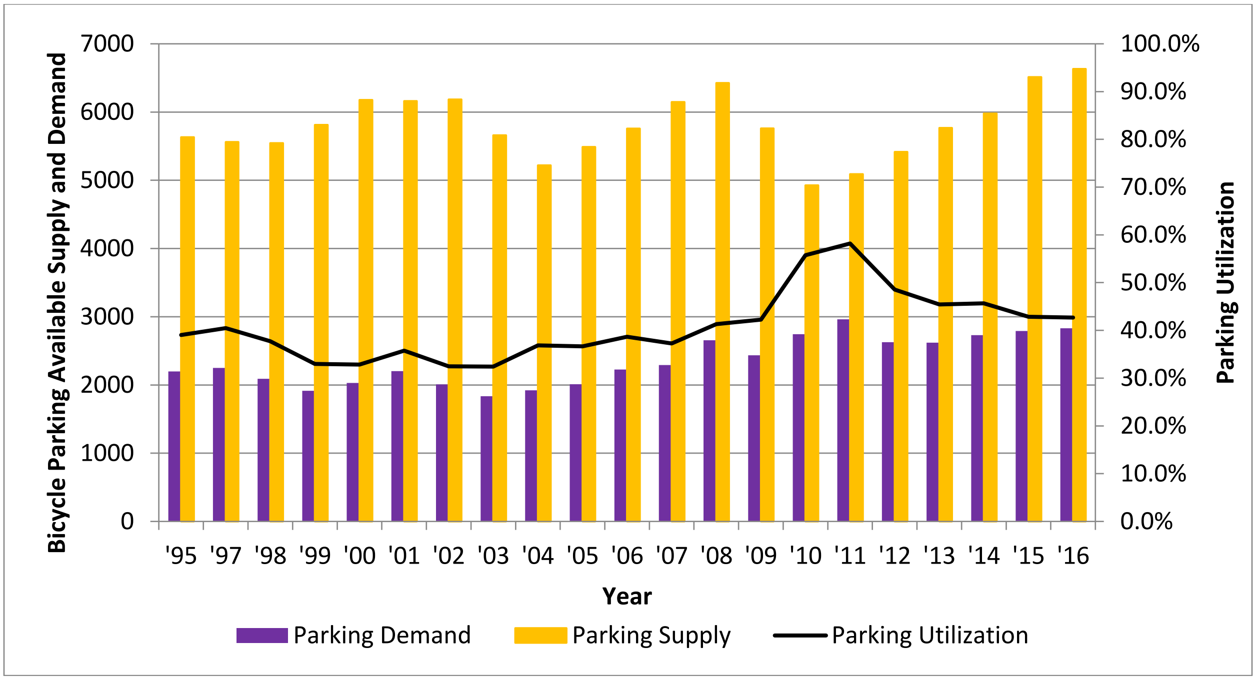
Figure 3.14 Existing (2016) Bicycle Rack Locations



Source: UWTS, 2016.

Figure 3.15 Existing (2016) Secure Bicycle House and Locker Locations

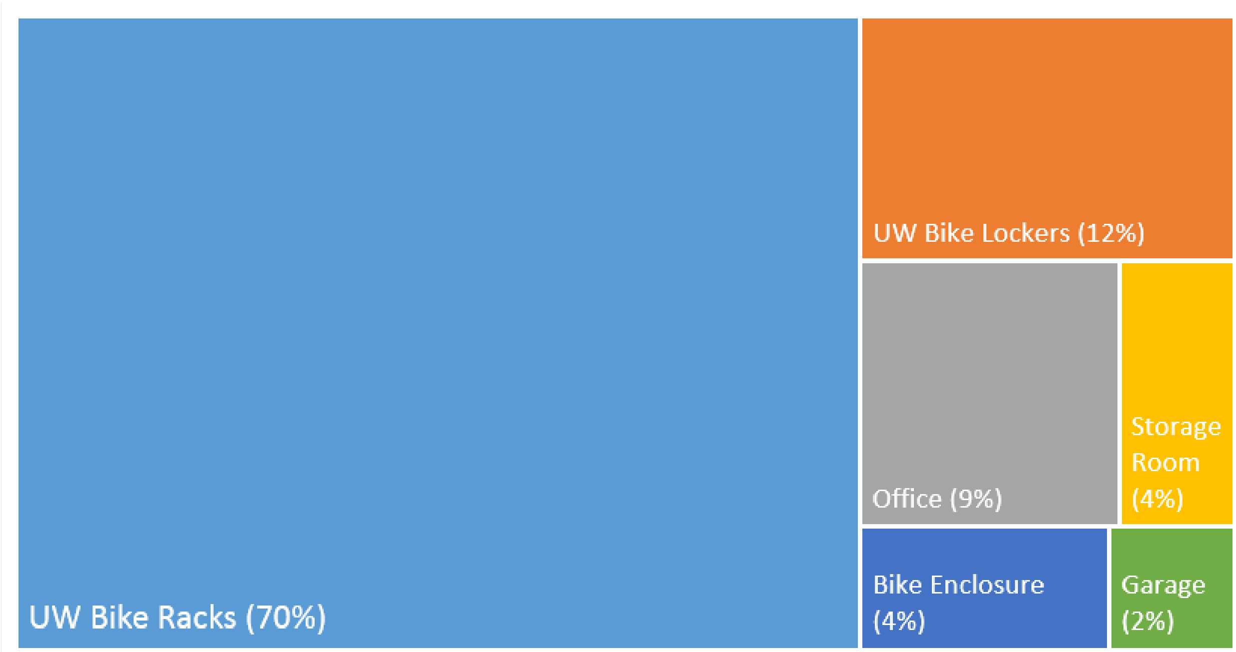
Figure 3.16 shows bicycle parking utilization trends from 1995 to 2016. The increase in bicycle parking utilization between 2009 and 2011 is a reflection of adjustments for real-world rather than theoretical capacity. Since then, the University of Washington has increased capacity by roughly 1,500 spaces. At the same time, utilization has dropped by about 20 percent from its peak. These statistics demonstrate how the University has effectively managed ongoing needs by ensuring that bicycle parking supply outpaces demand.



Source: UWTS, 2016

Figure 3.16 Campus-Wide Bicycle Parking Utilization Trends

Data shown in Figure 3.17, which is derived from the biennium transportation telephone survey of students, faculty, and staff, suggests that 30 percent of these populations do not use the bicycle racks provided by the University of Washington. The survey indicates that, overall, an estimated 82 percent of campus bicycle riders use bicycle storage facilities provided by the University. Of this number, some 70 percent use bicycle racks throughout campus and 12 percent use bicycle lockers. This data, in combination with other survey results, seems to indicate an ongoing desire for more secure bicycle storage on campus. The University is working to address this issue, especially as part of new construction.



Source: UWTS

Figure 3.17 Bicycle Parking Locations

Bikeshare Program

The Pronto Cycle Share program (Pronto) was managed by the City of Seattle to promote biking and reduce dependence on automobiles. Eleven Pronto stations were positioned within the primary and secondary impact zones. These stations located in the University District are shown in Figure 3.18. As of March 31, 2017, the City of Seattle has discontinued the program.

Source: Transpo Group, 2015

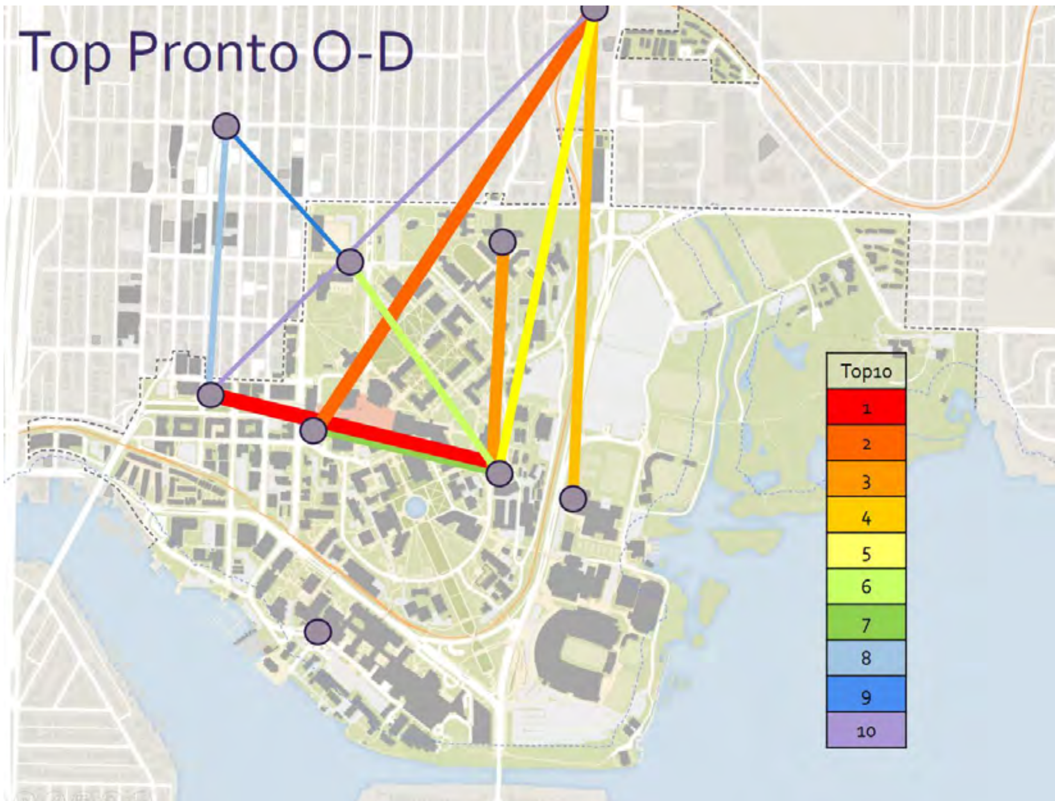
Figure 3.18 Pronto Cycle Share Stations

The performance of the Pronto program on the University of Washington campus was low in comparison to other Pronto stations. Based on 2015 Pronto ridership data, all University of Washington stations averaged four Pronto trips per station per day or fewer and ranked in the bottom 30 percent in average trips per day. The most frequently used Pronto station was located at the 12th Avenue NE/NE Campus Parkway intersection, with 4.14 trips per day. The fewest Pronto trips per day (1.22) occurred at the McCarty Hall/Whitman Court station.

In comparison, the highest volume of Pronto trips per day (over 15) occurred at the 3rd Avenue/Broad Street station in Downtown Seattle. The most common trip to and from U District Pronto stations occurred between the 12th Avenue/NE Campus Parkway station and the East Stevens Way NE/Jefferson Road station. With the opening of the light rail University of Washington Station, Pronto use was expected to increase. The light rail station is currently the end of the line, which could have made bicycle mode options more desirable.

The top 10 origin-destination pairs for historic Pronto use in the U District are shown in Figure 3.19. The map indicates that travel to/from the HUB was popular for short trips between areas of campus. The data also shows that three of the top five origin-destinations involved the station near 25th Ave NE and

Ravenna Place NE near Nordheim Court, which is a flat, comfortable bicycle ride to campus via the Burke-Gilman Trail.



Source: Transpo Group, 2015

Figure 3.19 Top Pronto Origin-Destination Pairs

3.3.3 Bicycle Counts

Bicycle ridership data from the SDOT includes 2011 and 2012 bicycle counts at intersections throughout Seattle, including three U District locations.

Table 3.14 summarizes bicycle counts and suggests that bicycle travel is increasing in these locations.

Table 3.14
ANNUAL BICYCLE VOLUMES AT U DISTRICT LOCATIONS

Location	2012 Total	2011 Total	Percent Change	Absolute Change
NE 45th Street/Brooklyn Avenue NE	765	579	32%	186
Montlake Boulevard NE/NE Pacific Street	2,188	1,817	20%	371
University Bridge	2,768	1,815	53%	953

Source: SDOT, 2012.

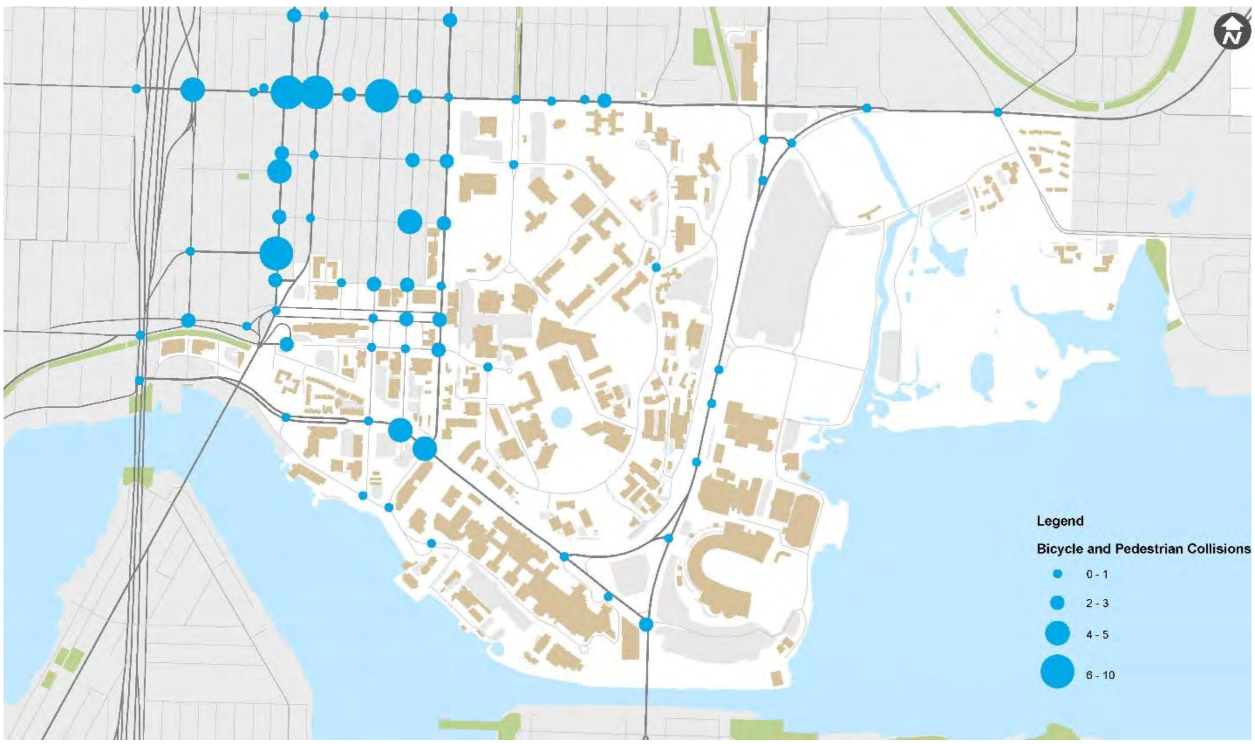
Additional bicycle volumes along the Burke-Gilman Trail are provided in Figure 3.21. Bicycle mode share growth trends for students and staff have been somewhat flat from 2009 to 2014

3.3.4 Bicycle Collision Data

Collision data for bicycles was also evaluated for the years 2008–2015 by UWTS and are reported with pedestrian-related collisions in Figure 3.8. Based on this data, bicycle-vehicle collisions are the highest reported with roughly 40 collisions per year.

Figure 3.20 summarizes bicycle and pedestrian collisions in the study area during the previous five-year period. Intersections with the highest number of collisions during that period are listed below:

- 11th Avenue NE/ NE 45th Street
- Brooklyn Avenue NE/ NE 45th Street
- Roosevelt Way NE/ NE 45th Street
- Roosevelt Way NE/ NE 42nd Street



Source: Transpo Group, 2016

Figure 3.20 Bicycle and Pedestrian Collisions

A review of the data provided by SDOT for the primary and secondary impact zone also addresses bicycle collisions; they are described in Section 3.5.4, Collision History.

3.3.5 Performance Measures

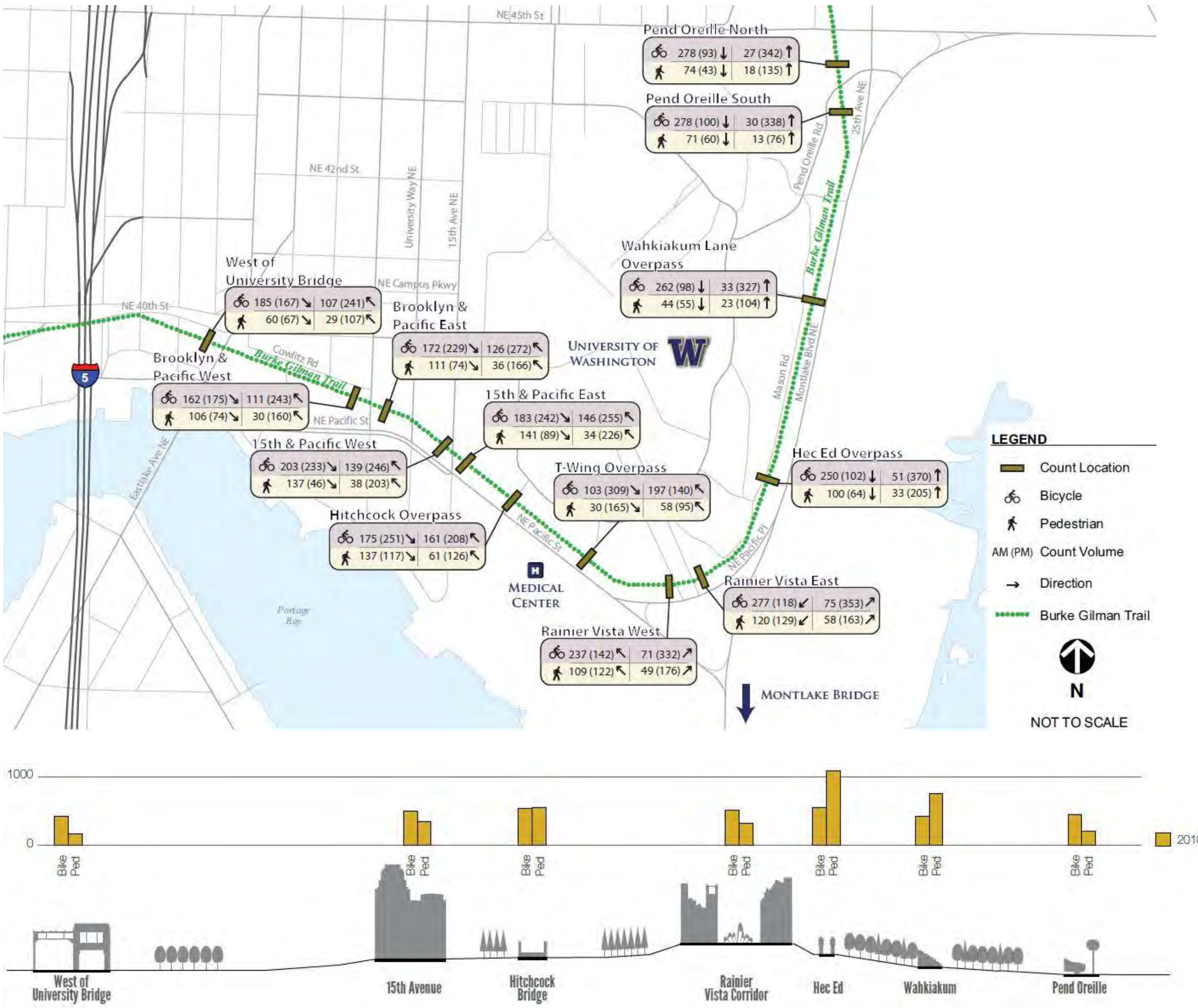
The following bicycle system performance measures have been developed to assess and compare alternatives:

- Burke-Gilman Trail Capacity
- Bicycle Parking and Utilization
- Quality of Bicycle Environment

These measures include a mixture of quantitative and qualitative measures. They are described in more detail throughout this section.

Burke-Gilman Trail Capacity

The University of Washington owns the Burke-Gilman Trail throughout the MIO. The University conducted two detailed studies, one in 2011 to study the trail and one in 2012 to define a plan, that identify how best to improve the capacity and aesthetics of the corridor. Weekday AM and PM count volumes from the 2010 study of pedestrians and bicycles are shown in Figure 3.21; PM peak hour counts are summarized in Table 3.15.



Source: University of Washington Burke-Gilman Trail Corridor Study, July 2011

Figure 3.21 Pedestrian and Bicycle Counts Along Burke-Gilman Trail Corridor

Table 3.15
2010 BURKE-GILMAN TRAIL WEEKDAY PM PEAK HOUR PEDESTRIAN AND BICYCLE COUNTS

Location	Bicycle Count (Both Directions)	Pedestrian Count (Both Directions)
West of University Bridge	408	174
West of 15th Avenue NE	479	249
Hitchcock Bridge	459	243
T-Wing Overpass	449	260
Rainier Vista West	474	298
Hec Edmundson Bridge	472	269
Wahkiakum Lane	425	159
South of Pend Oreille Road NE	438	136
North of Pend Oreille Road NE	435	178

Source: University of Washington Burke-Gilman Trail Corridor Study, July 2011

Combined, these two studies provide a long-term study and implementation plan for the trail including ongoing capital investments. Recent upgrades were completed along the trail between 15th Avenue NE and Rainier Vista, along parts of West Campus, and at the bridge connection to the University of Washington Station. The previous trail design mixed pedestrian and bicycle uses; the improvements separate pedestrian and bicycle modes. Ultimately improvements to the Burke-Gilman Trail, separating the trail for its entire length through the campus as noted in the 2012 plan will meet long term needs and address pedestrian-bicycle conflict points through grade separation and bicycle speed control tactics.

Burke-Gilman Trail Level of service was evaluated with methods used in the 2011 and 2012 studies, including the use of the Federal Highway Administration's Shared-Use Path Level of Service Calculator (SUPLOS). SUPLOS evaluates trail segments using factors including trail width, directional bicycle and pedestrian volumes, and the presence of a striped centerline. (University of Washington Burke-Gilman Trail Corridor Study, July 2011). Existing level of service includes 2010 weekday PM peak hour pedestrian and bicycle counts in the operational analysis. The existing weekday PM peak hour level of service along trail segments is summarized in Table 3.16.

Table 3.16
EXISTING BURKE-GILMAN TRAIL WEEKDAY PM PEAK HOUR LEVEL OF SERVICE

Location	Level of Service Score	Level of Service Grade
West of University Bridge	3.74	B
West of 15th Avenue NE	3.71	B
Hitchcock Bridge	3.80	B
WWMC T-Wing Overpass	4.12	A
Rainier Vista West	3.10	C
Hec Ed Bridge	2.85	D
Wahkiakum Lane	2.04	E
South of Pend Oreille Road NE	2.15	E
North of Pend Oreille Road NE	1.89	F

Pedestrian-bicycle conflict points along the Burke-Gilman Trail, along with collisions that occurred on the trail between 2008 and 2014, are shown in Figure 3.22 below. Locations with a higher number of collisions in the primary impact zone within the MIO boundary include trail intersections at 15th Avenue NE and Adams Lane NE (near the Mercer Court residence halls). In the primary impact zone but outside of the MIO boundary, bicycle collisions occurred along the Burke-Gilman Trail at the Latona Avenue NE/ NE Pacific Street, 25th Avenue NE/ NE Blakeley Street, and Union Bay Place NE/ NE 49th Street intersections.

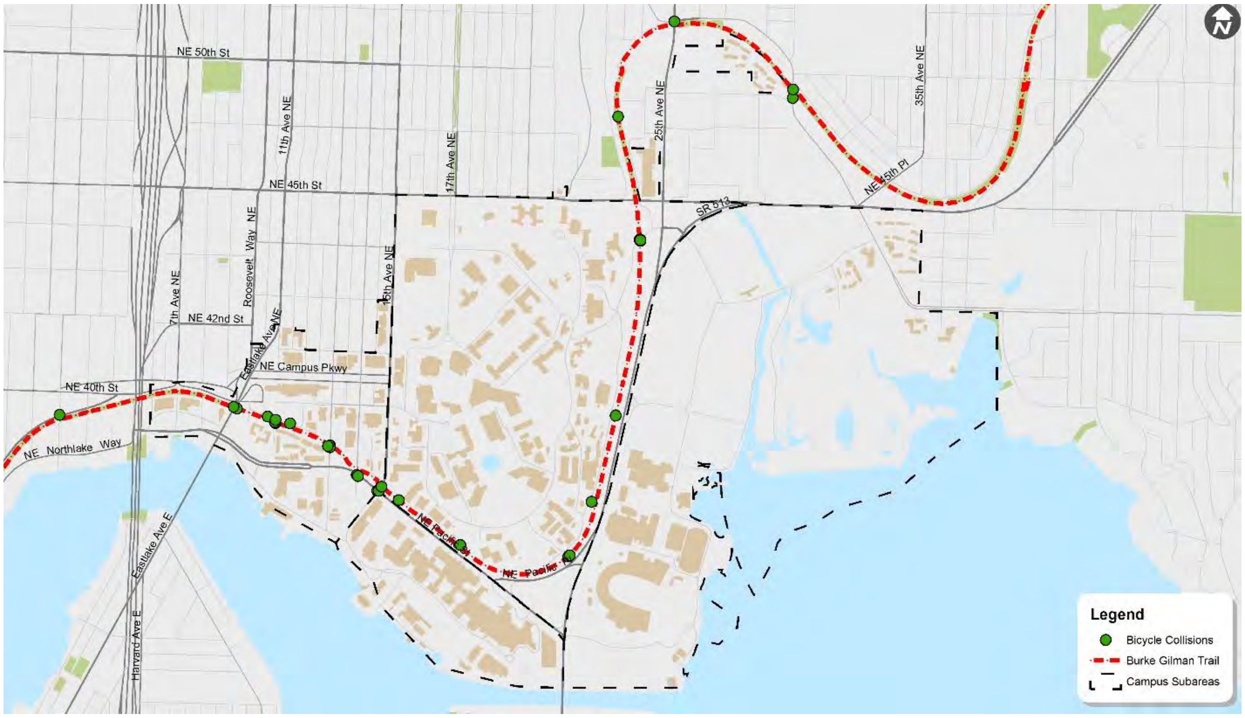


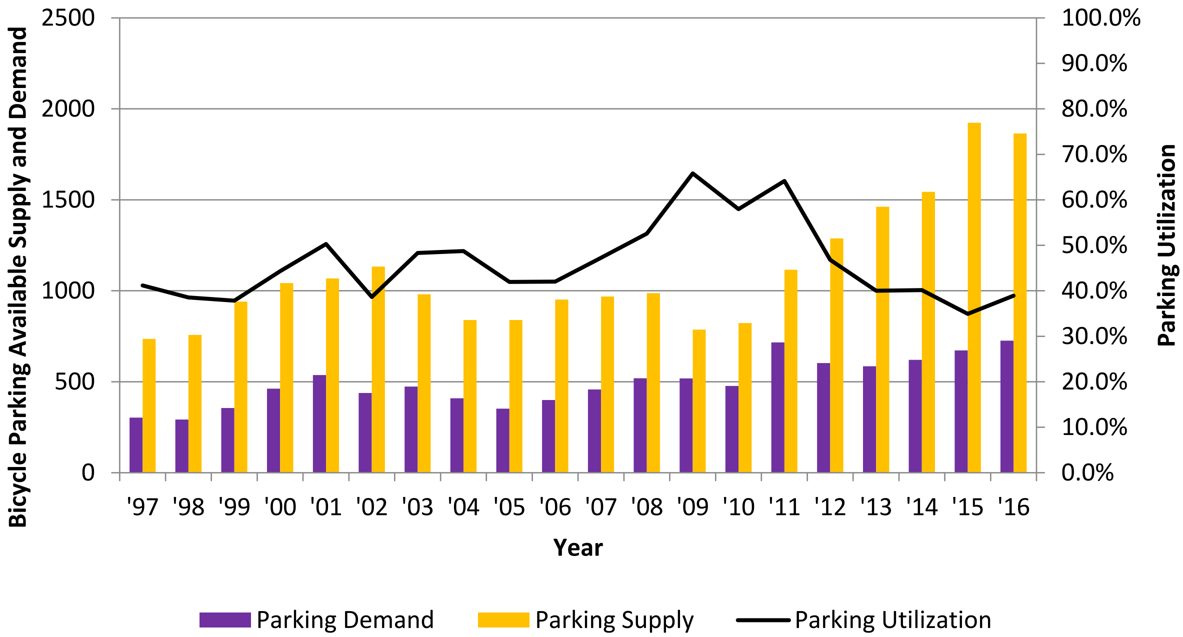
Figure 3.22 Burke-Gilman Trail Bicycle Collision Locations

Pedestrian and bicycle collision analysis is described in detail in Section 3.2.3, Pedestrian and Collision Data, Section 3.3.4, Bicycle Collision Data, and Section 3.5.4, Collision History.

Bicycle Parking and Utilization

As discussed in Section 3.3.2, Bicycle Parking and Bicycle Share Facilities, the University has a long track record of managing bicycle parking supply, ensuring that it can meet demand from students, faculty, and staff. Bicycling is an important travel mode for these populations because it helps to reduce drive alone trips to campus, is relatively inexpensive to promote (compared to transit), and is highly beneficial to health and the environment. Currently, the University provides roughly twice the number of bicycle parking spaces as required by the City of Seattle Municipal Code (SMC 23.54.015.K.1). To stay ahead of demand, the University continues to add parking spaces, especially those that are covered and include security features.

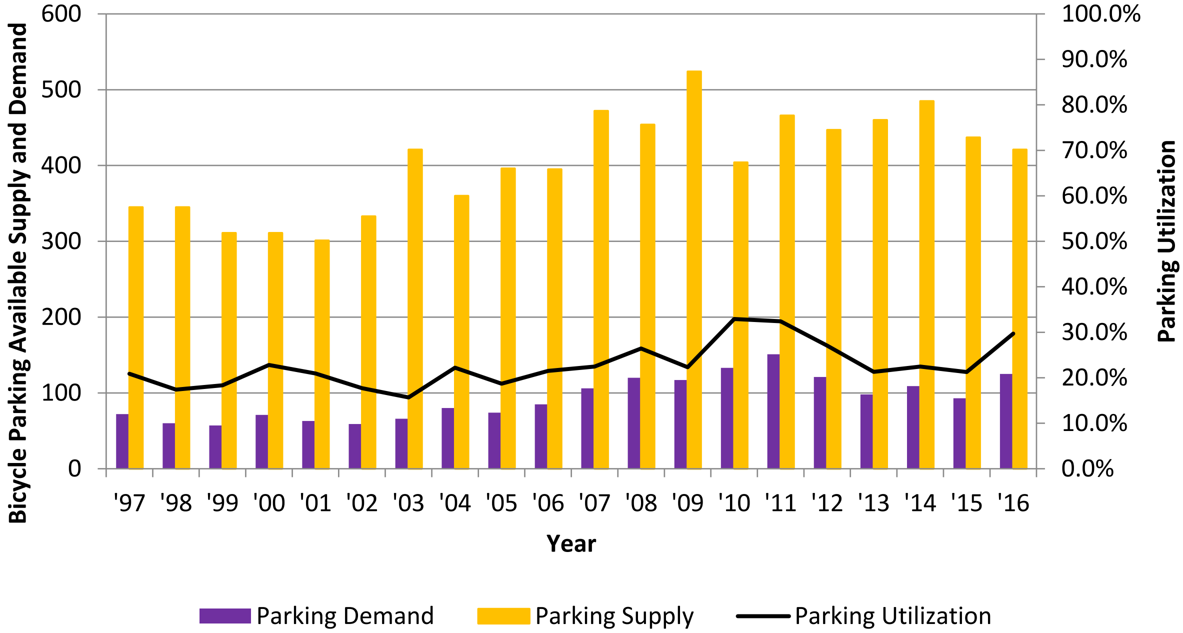
Figure 3.23 below shows bicycle parking supply, demand, and utilization from 1997 through 2016 in West Campus, which has seen redevelopment of numerous University-owned properties over the last five years. As one of the more heavily utilized bicycle parking areas, this figure shows that the University has nearly doubled bicycle parking supply in this growing area which more than meets the demand for parking. University-wide data is discussed in Section 3.3.2, Bicycle Parking and Bicycle Share Facilities, and shows bicycle parking needs are being met and utilization has gone down from a high in 2010–2011.



Source: UWTS, 2016.

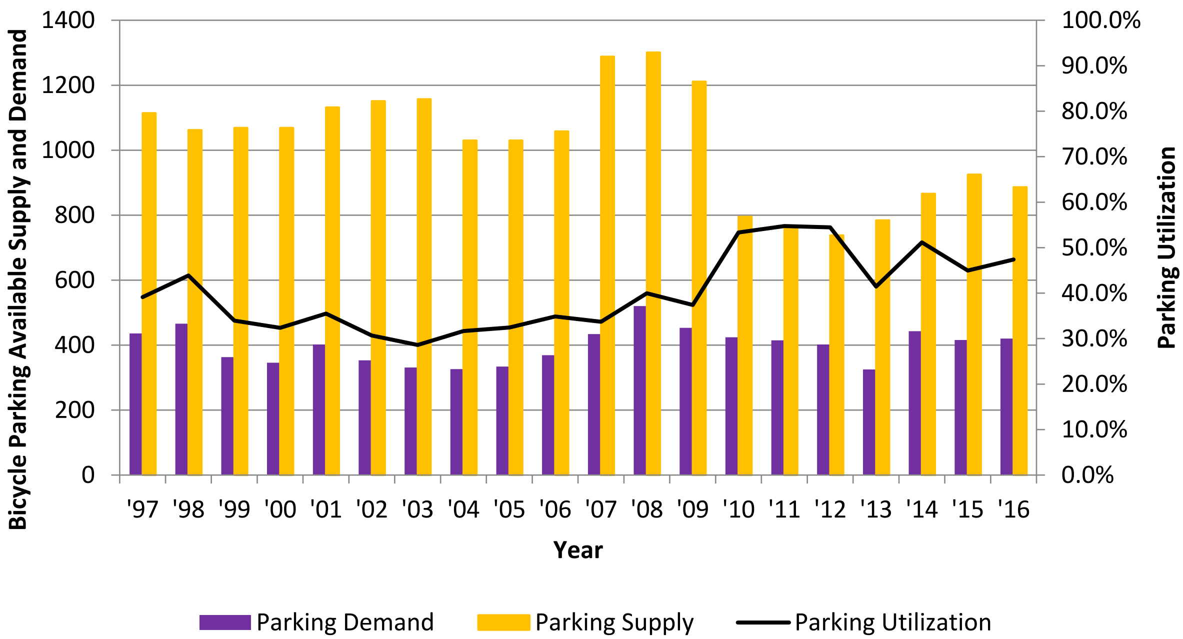
Figure 3.23 Bicycle Parking in West Campus

Figure 3.24, Figure 3.25, and Figure 3.26 show bicycle parking supply, demand, and utilization in East Campus, South Campus, and Central Campus, respectively. Similar to West Campus data in Figure 3.23, the following graphs show utilization trends from 1997 through 2016.



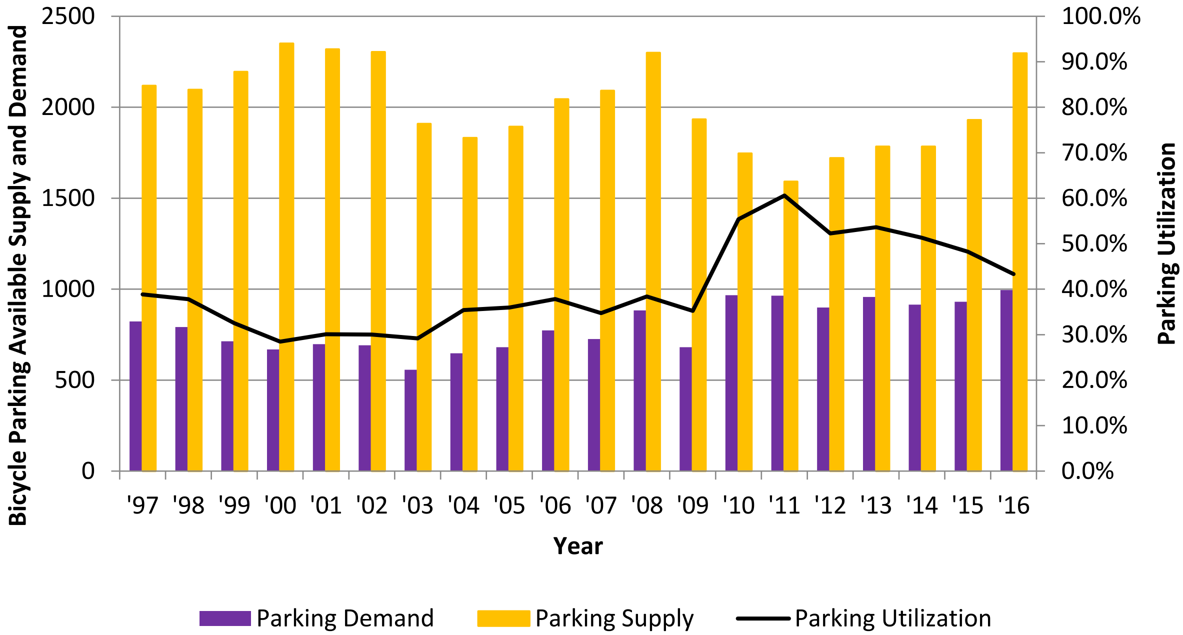
Source: UWTS, 2016.

Figure 3.24 Bicycle Parking in East Campus



Source: UWTS, 2016.

Figure 3.25 Bicycle Parking in South Campus



Source: UWTS, 2016.

Figure 3.26 Bicycle Parking in Central Campus

As shown in West Campus, as sites are redeveloped additional bicycle parking supply has been provided. Additionally, although supply in East and South Campus has decreased since 2009 the demand is still being met. The above data show that the University has effectively managed bicycle parking demand, as new buildings are constructed; more than sufficient parking supply is provided. For these reasons, additional bicycle parking analysis for the development alternatives was not completed.

Quality of Bicycle Environment

Bicycle travel in the primary and secondary impact zones has seen recent improvements; however, some long-standing connectivity gaps remain. This qualitative assessment of the bicycle environment provides comparisons between the development alternatives where discernible, and includes projects by the SDOT, WSDOT, and the University of Washington. In general, bicycle travel does not face capacity limitations, so this assessment focuses primarily on improvements to the bicycle network and general changes to travel patterns and demand. Bicycle travel on the Burke-Gilman Trail, which can have capacity issues, is analyzed above.

The Burke-Gilman Trail currently provides a strong bicycle backbone through much of the primary and secondary impact zones with connections throughout the area. In Central Campus Grant Lane, and Memorial Way provide access to the campus, while circulation around campus primarily occurs along Stevens Way, although none of these roads has dedicated bicycle facilities. Bicyclists use paths noted as minor routes on the Pedestrian system to travel through campus; however, during passing periods, their travel in the Central Campus is restricted both by University policy and the capacity limitations of paths.

The bicycle network in West Campus is more developed and of higher quality with a number of protected bicycle lanes and other shared facilities. Several additions to this area are fairly new; however, some gaps exist. South Campus and East Campus have limited bicycle networks and access to/from the Burke-Gilman Trail represents their primary bicycle connection.

The new pedestrian and bicycle bridge to the University of Washington Station improves travel between the Burke-Gilman Trail and the Montlake area; however, the Montlake Bridge and I-5 represent long-standing barriers to bicycle travel.

Bicycle facilities exist within the secondary impact zone, providing connections to the Burke-Gillman Trail. Along 40th Avenue NE, east of the primary impact zone, a Neighborhood Greenway provides a north/south connection from the Burke-Gillman Trail. Latona Avenue NE and 2nd Avenue NE include local in-street bicycle lanes within the secondary impact zone, west of the primary impact zone. These lanes connect north/south to the Burke-Gillman Trail, also providing a link to an east/west local Neighborhood Greenway along N 44th Street.

Sections 3.3.4, Bicycle Collision Data, and 3.5.4, Collision History, offer detailed information about bicycle collisions in the study area. As stated previously, bicycle-vehicle collisions are the highest reported, with roughly 40 collisions per year between 2008 and 2015. As described in Section 3.5.4, Collision History, and listed below, three locations in the study area are identified by SDOT as High Collision Locations (HCL), meeting the criteria of five or more pedestrian or bike collisions in the previous three-year period:

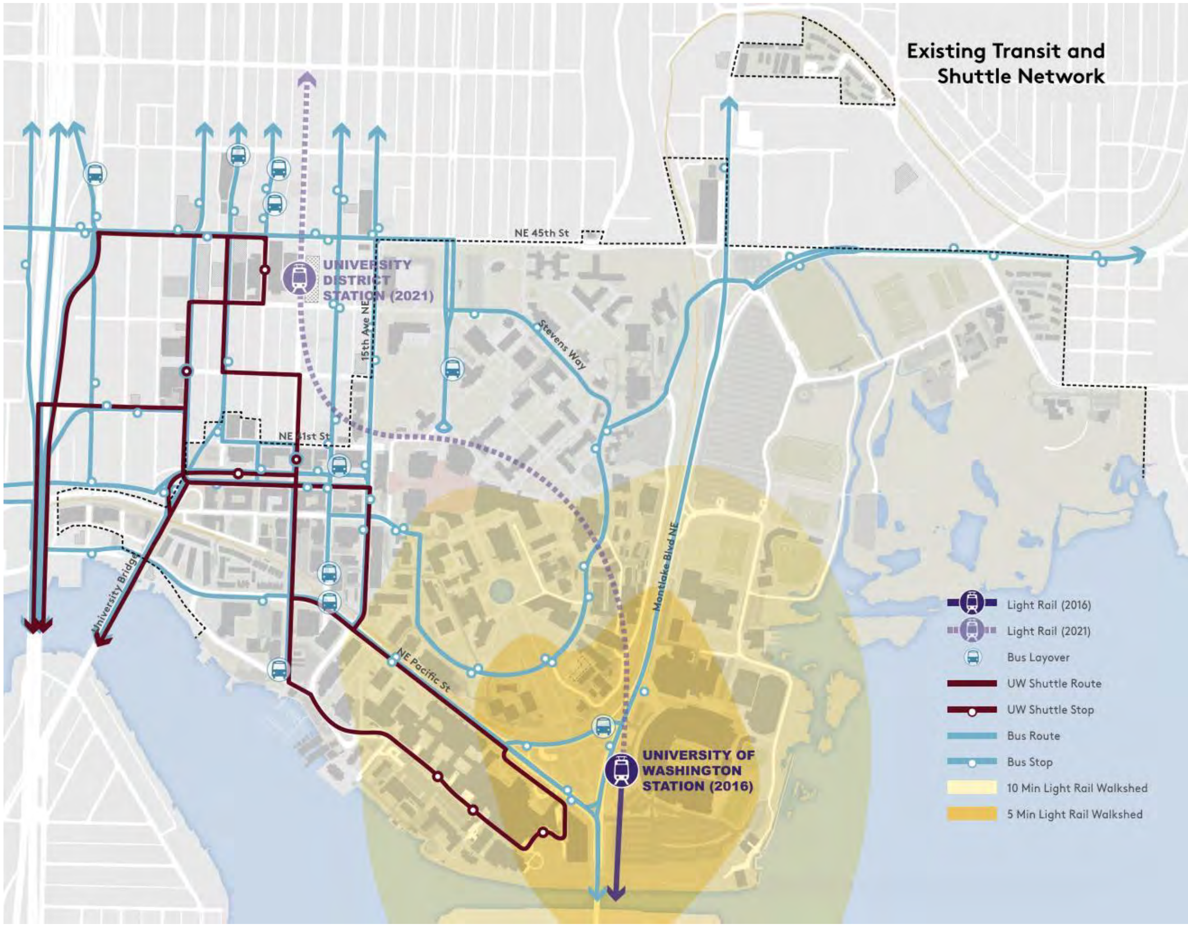
- Brooklyn Avenue NE/ NE 45th Street
- Brooklyn Avenue NE/ NE 50th Street
- Roosevelt Way NE/ NE 45th Street

3.4 TRANSIT

Of the campus community, approximately 29,000 people `access the University of Washington using transit, based on mode share data shown in Table 3.2. Of these trips, almost 19,900 are students, some 2,000 are faculty, and 7,280 are staff.

3.4.1 Transit Stops and Facilities

The transit network throughout the University of Washington campus and surrounding U District incorporates King County Metro (Metro), Sound Transit (ST), Community Transit (CT), and the recent University of Washington Station at Husky Stadium. Figure 3.27 shows existing transit facilities throughout the University of Washington campus, including shuttles and public transit. The figure includes walksheds from the existing light rail station, which currently serves as the end of the line and requires integration with all modes of travel to campus and surrounding neighborhoods. Figure 3.27 also indicates current layover areas along Memorial Drive, University Way, Brooklyn Avenue, and 12th Avenue. Layover locations were negotiated in an agreement between Metro and the City of Seattle in 1999.

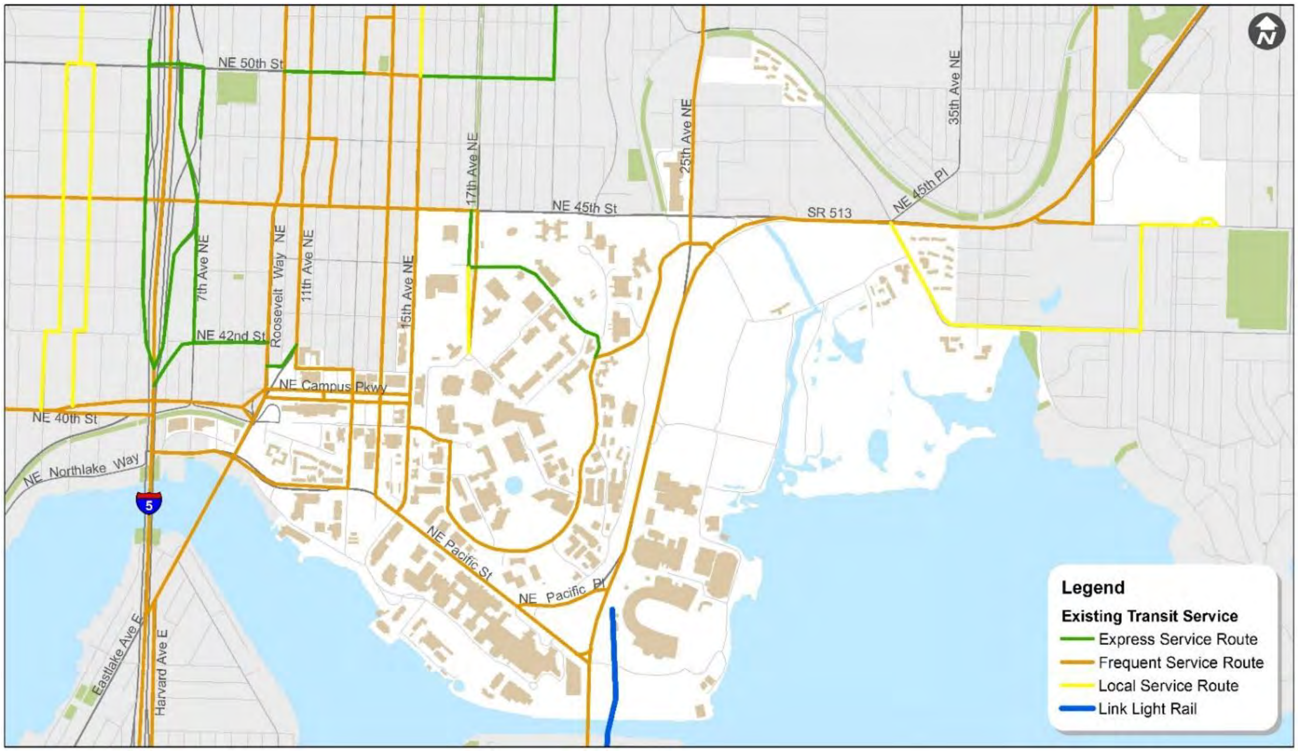


Source: Sasaki Architects, July 2017 CMP

Figure 3.27 Existing Transit Network and Light Rail Walkshed

3.4.2 Existing Routes/Layover and Connections

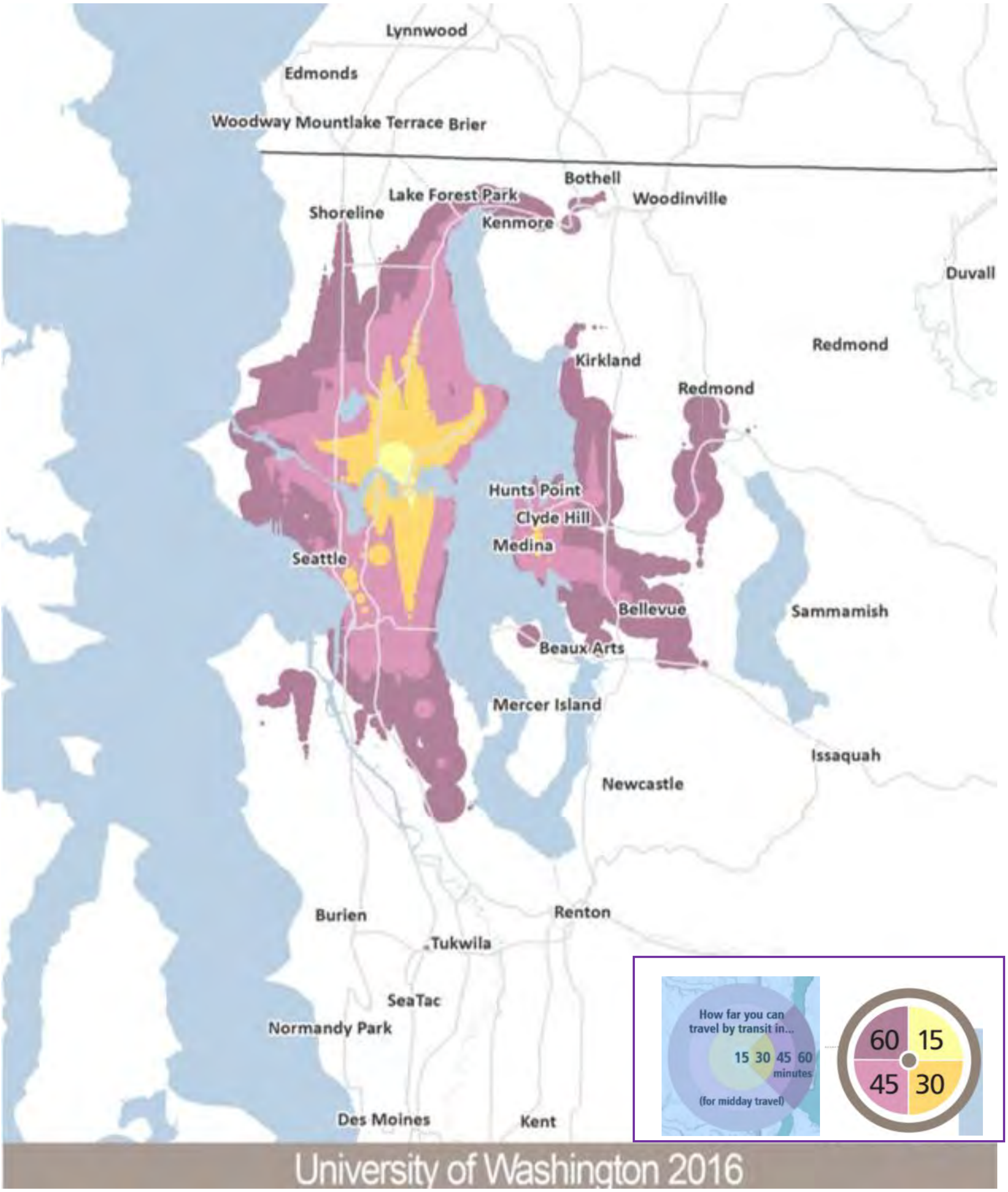
Figure 3.27 shows Metro transit lines after the March 2016 service changes. Routes were restructured to provide better connections to the existing and upcoming light rail stations.



Source: King County METRO CONNECTS, 2016

Figure 3.28 Existing Transit Service Types

Figure 3.29 shows travel times from the University of Washington using existing (2016) transit service, as provided in the 2016 METRO CONNECTS Plan. Colors indicate travel times from the University of Washington within 15, 30, 45, and 60 minutes, as shown in the legend.

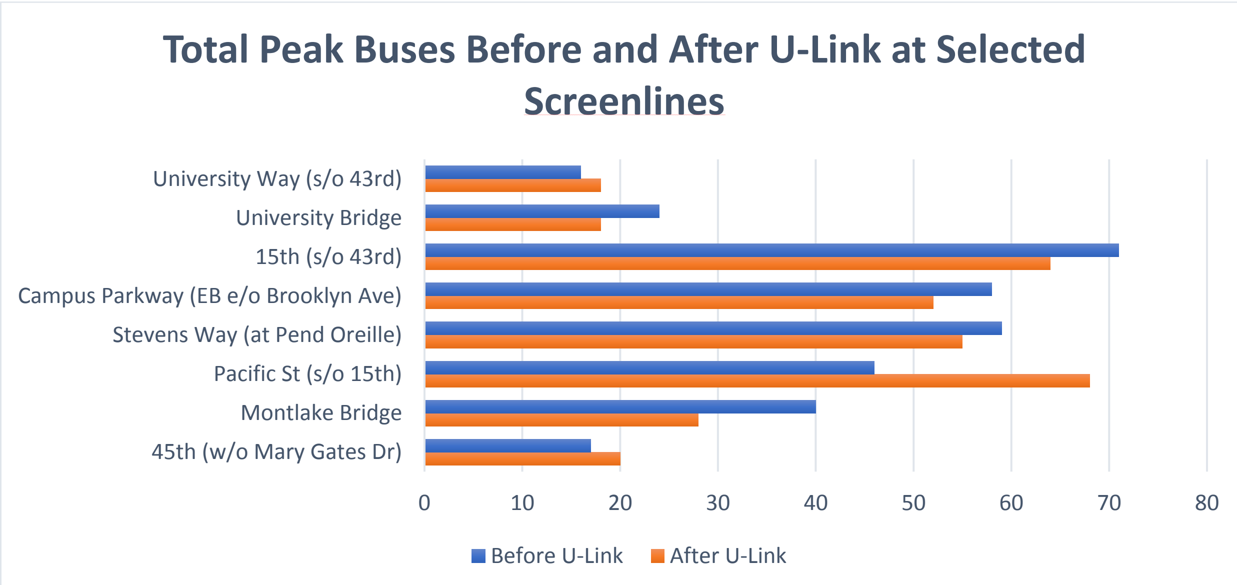


Source: King County METRO CONNECTS, 2016

Figure 3.29 Existing (2016) Transit Travel Times from the University of Washington

Figure 3.29 also shows that existing Metro transit service provides access within 60 minutes to the Seattle area, as well as north to Shoreline, Kenmore, and Bothell, and east to Redmond, Kirkland, and Bellevue. These travel times include transfers.

Figure 3.30 shows peak hour bus volumes grouped by screenline location, for pre- and post- U-Link (light rail extension to the University of Washington Station) opening. Transit volumes have decreased at the University Bridge, 15th Avenue NE, Campus Parkway, Stevens Way, and Montlake Bridge screenlines due to service changes that orient to the University of Washington Station. In contrast, peak hour bus volumes at the University Way NE, NE Pacific Street, and NE 45th Street screenlines have increased since the station opened. These revisions reflect a service concept integrated with the light rail station.



Source: UWTS, 2016

Figure 3.30 Peak Buses per Hour by Screenline Location Before and After Opening of U-Link

Figure 3.31 below illustrates the available transit connections from the University of Washington Station. Bus routes 31, 32, 65, 67, 75, 78, and 372 are accessible via an estimated five-minute walk to Stevens Way NE. Routes 65 and 78 are accessible with an estimated two-minute walk north on Montlake Boulevard NE. Routes 43, 44, 45, 48, 71, 73, 167, 271, 277, 373, 540, 541, 542, 556, and 586 are accessible via an estimated two-minute walk to connection points at NE Pacific Street adjacent to the University of Washington Medical Center.

Source: Transpo Group, 2015

Figure 3.31 Available Transit Connections from University of Washington Station

Initial data of light rail ridership after the University of Washington Station opened in March 2016 are shown in Table 3.17, indicating an overall increase of 13 percent over a one-year period.

Table 3.17
CHANGE IN U-PASS USE – COMPARISON OF MAY 2015 TO MAY 2016 (AFTER OPENING OF U-LINK LIGHT RAIL)

Services	2015	2016	Changes	Ratio
By Provider				
Community Transit	28,468	28,834	366	1%
Everett Transit	227	216	-11	-5%
King County Metro	614,834	582,836	31,998	5%
Kitsap Transit	610	958	348	57%
Pierce Transit	1,147	1,056	-91	-8%
Sound Transit	65,378	189,827	124,449	190%
By Mode				
Bus	46,671	51,189	4,518	10%
Demand Response	2	81	79	3,950%
Commuter Rail	4,697	5,682	985	21%
Light Rail	14,008	132,875	118,867	849%
Total	**710,664**	**803,727**	**93,063**	**13%**

Source: UWTS, 2016

3.4.3 Transit Walkshed and Connectivity

Providing walkable access to transit ensures that it will remain a viable transportation choice. With existing transit walksheds, the recently opened University of Washington light rail station is within a 10-minute walk of approximately half the campus. With the anticipated opening of the U District Station in 2021, most of the campus would be within a 10-minute walk of light rail.

3.4.4 Performance Measures

Transit is critical for the mobility of University of Washington populations. Every day, roughly 4 out of 10 students, faculty, and staff use transit facilities to get to and from campus. The following transit performance measures have been developed to assess and compare alternatives:

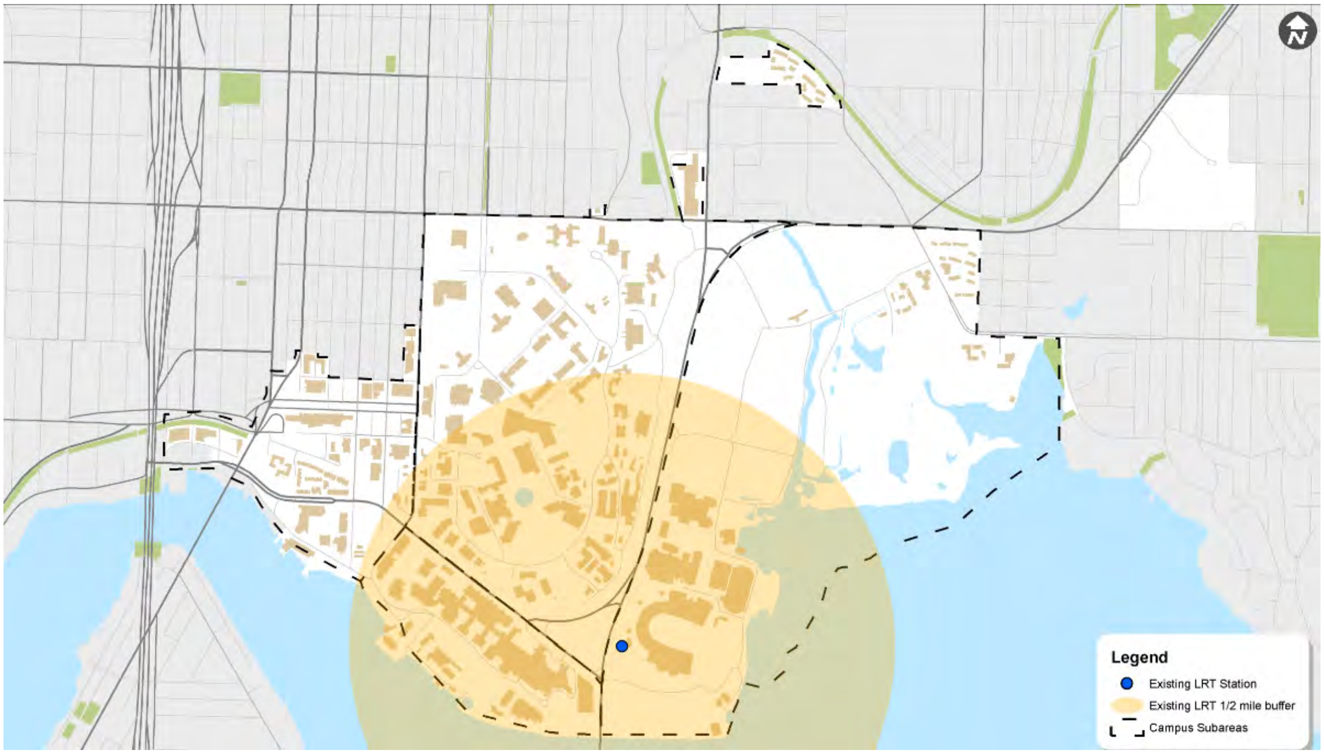
- Proportion of Development Within 1/4 Mile of RapidRide
- Proportion of Development Within 1/2 Mile of Light Rail
- Transit Stop Capacity
- Transit Travel Times and Delay
- Transit Loads at Screenlines

Proportion of Development Within 1/4 Mile of RapidRide

This measure determines the proportion of development within 1/4 mile of RapidRide service to the University of Washington. Proximity to transit is an important factor in ridership. Since 40 percent of trips to and from the University of Washington are currently on transit, this measure can help to inform how each of the development alternatives would perform relative to transit accessibility. Currently, no RapidRide service is provided to the University of Washington; however, changes will take place in the future No Action case and for each development alternative.

Proportion of Development Within 1/2 Mile of Light Rail

This measure determines the proportion of development within a 1/2 mile walkshed of light rail stations. With future development alternatives, proximity to light rail will include the U District Station assumed to be completed in 2021. Proximity to transit is an important factor in transit ridership. Since 40 percent of trips to and from the University of Washington are currently on transit, this measure can help to inform how each of the development alternatives would perform relative to transit accessibility. The current 1/2 mile proximity to the University of Washington Station is shown in Figure 3.32 below.



Source: Transpo Group, 2016

Figure 3.32 1/2-Mile Walkshed of Existing Light Rail

In future scenarios, the proportion of new development within the 1/2 mile walkshed of campus will be measured. In the existing condition, the total area of each campus sector was measured instead. Table 3.18 below shows that a little more than half of the campus area is within a 1/2 mile proximity to light rail.

Table 3.18
PROPORTION OF EXISTING CAMPUS WITHIN ½ MILE OF LIGHT RAIL

Sector	Existing
West	6%
South	100%
Central	49%
East	42%
Total	**54%**

Transit Stop Capacity

This measure evaluates the ability of transit stops and curb spaces to accommodate the buses that are predicted to use the stops within a one-hour period. This analysis was conducted for four pairs (one in each direction) of stops on the busiest transit corridors around the University of Washington: 15th Ave NE, NE 45th St, Montlake Boulevard, and Pacific Street, as shown in Figure 3.33. The following section summarizes the bus stop capacity and the bus demand at each of these stops within the affected environment.

Figure 3.33 Transit Stop Capacity Study Area

Existing Transit Stop Capacity and Demand

This measure applies the methods published in the Transit Cooperative Research Program (TCRP) Report 165 – Transit Capacity and Quality of Service Manual to develop estimates. The methodology incorporated inputs of stop dwell times, stop locations, stop types, proximity to intersections, conflicting right-turn volumes, and other data into a spreadsheet to estimate the number of buses that each stop could process within one hour. The number of buses traveling through each stop was taken from the current scheduling of Metro, CT, and ST services. The results of this analysis are provided in Table 3.19.

Table 3.19
TRANSIT STOP CAPACITY AND EXISTING DEMAND

Stop	Capacity (buses/hour)	Existing Demand (buses/hour)
NE 15th Avenue at NE 42nd Street (NB)	68	30
NE 15th Avenue at NE43rd Street (SB)	69	30
NE 45th Street & University Way NE (EB)	56	18
NE 45th Street & Brooklyn Avenue NE (WB)	39	18
NE Pacific Street & 15th Avenue NE (SEB)	70	35
NE Pacific Street & 15th Avenue NE (NWB)	82	35
Montlake Boulevard NE & Pacific Place (NB)	28	18
Montlake Boulevard NE & Pacific Place (SB)	67	18

As shown in Table 3.19 there is available capacity at each of the transit stops reviewed to accommodate current bus stop demand.

Transit Travel Times and Delay
This measure evaluates the PM peak hour transit travel speeds on key corridors around and on the University of Washington campus and the impact of background and CMP growth on travel time speeds. These corridors, which overlap with arterials evaluated for automobile travel, are shown in Figure 3.34 and listed below:

- NE 45th Street
- Pacific Street
- 11th Avenue NE
- Roosevelt Way NE
- 15th Avenue NE
- Montlake Boulevard
- Stevens Way NE

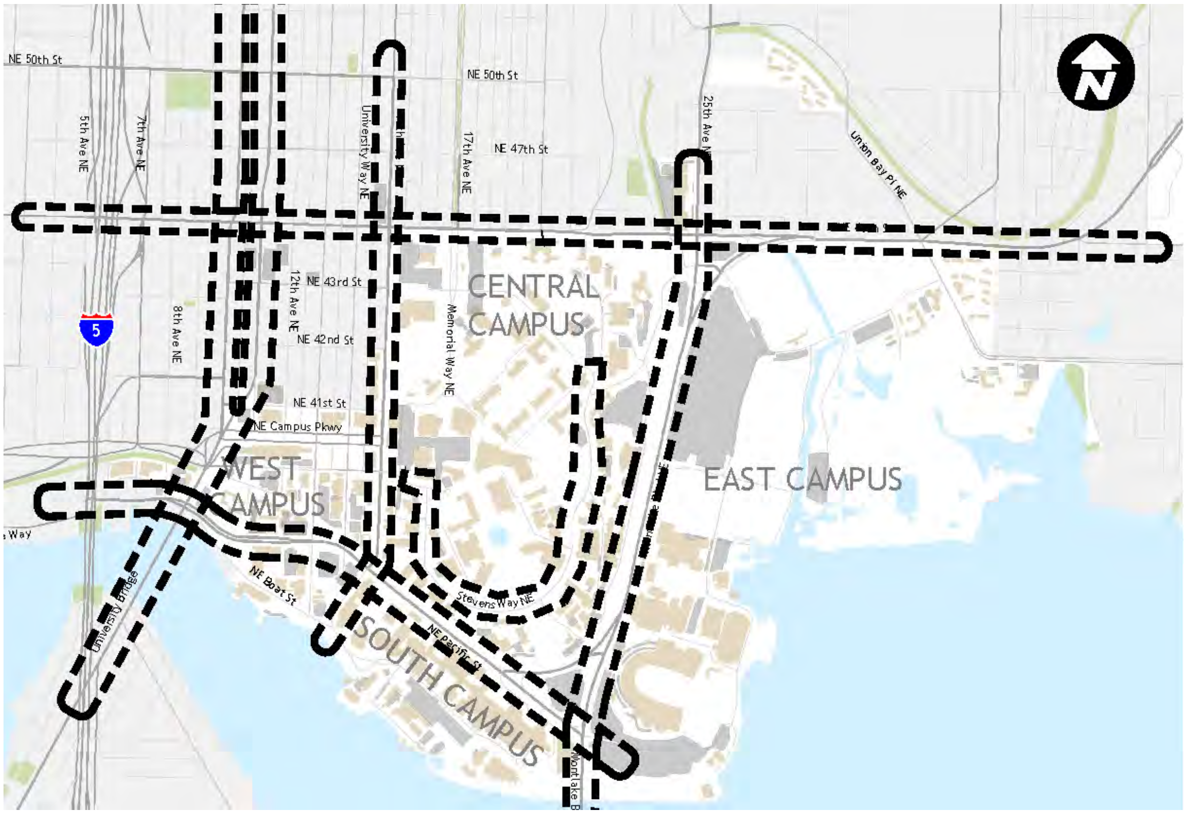
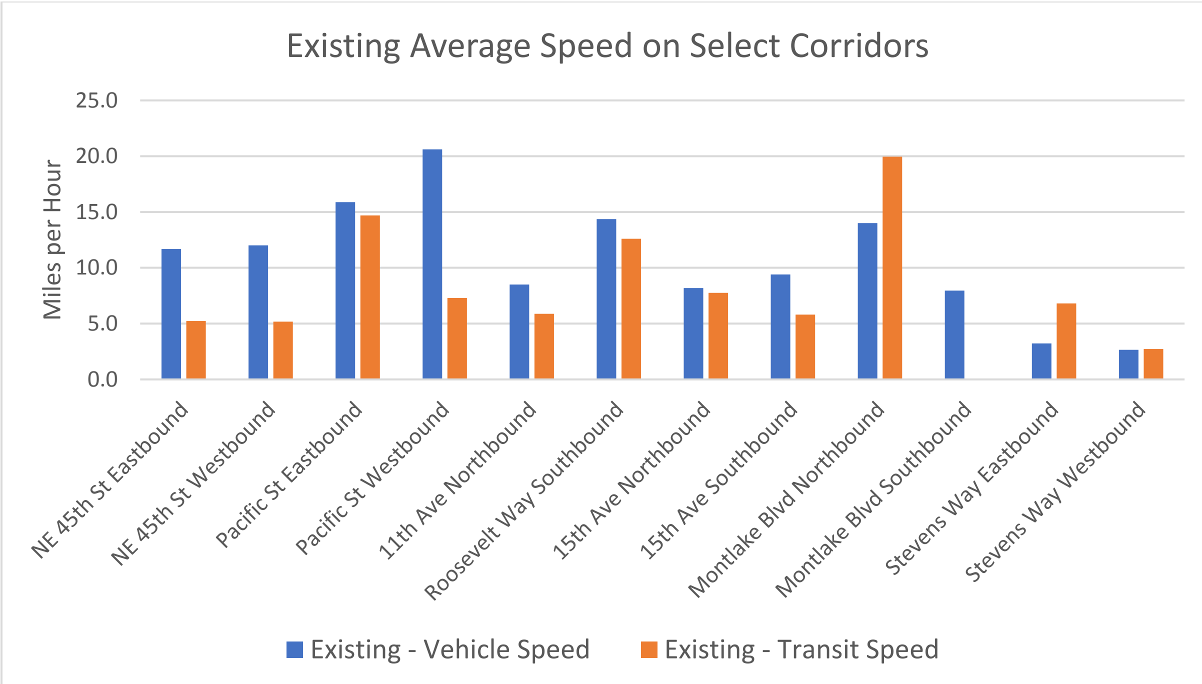


Figure 3.34 Transit Study Corridors

Existing Data

Existing transit speeds were measured from automatic vehicle location data for three days in October 2016. That three-day period occurred after the opening of the University of Washington Station and when student activity was normal. The data was provided by Metro, Community Transit, and Pierce Transit operating Sound Transit for all routes currently operating within and around the University of Washington. Transit speeds were evaluated by measuring roadway distances between stops, calculating the travel time between each stop (from arrival to arrival), and dividing the distances by the travel times. Figure 3.35 below shows the existing average transit and vehicle speeds (for comparison) on each corridor. Average vehicle speeds were calculated using Synchro and based on PM peak hour turning movement counts. These data were validated by field surveys of actual travel times using floating car surveys.



Source: Transpo Group, 2016

Figure 3.35 Existing Corridor Speed Comparison (Transit and Vehicle)

As shown in Figure 3.35, transit travel speeds are generally slower than those for automobiles because transit involves scheduled stops, slower vehicle speeds, and dwell times to pick up passengers. The greatest disparity in travel times was along NE Pacific Street in the westbound direction, where the bus travel speeds were nearly one-third slower than those for automobiles. However, there was one anomaly—northbound Montlake Boulevard—where transit travel speeds were noted to be faster than auto travel times. This was due in part to the lack of transit stops on Montlake northbound and potential vehicle queuing at driveways.

Transit Loads at Screenlines

This measure calculates the peak hour demand or load against available capacity on bus and light rail service at key transit corridors in the U District. These corridors are along NE 45th Street, Roosevelt Way, NE 11th Avenue NE, 15th Avenue NE, University Way NE, Campus Parkway, NE Pacific Street, Montlake and University bridges, and at the University of Washington and U District Light Rail stations. The following sections summarize transit screenline load demand and capacity within the affected environment. Demand and capacity values represent the number of available and occupied transit-user spaces on each transit mode.

Existing Data

Existing (2016) transit screenline load values were based on data collected at locations shown in Figure 3.36 below, which represented trips during the weekday PM peak hour. These values demonstrated peak transit demand and capacity, capturing the congestion generated during an average commute. All transit routes crossing these locations were evaluated across the screenlines shown in Figure 3.36 and listed in Table 3.21. Existing data were collected for both demand and capacity and were calculated using different methodologies:

- **Demand** – Existing demand values were collected from Average Passenger Count (APC) data received from Metro, Pierce Transit operating Sound Transit Regional Express, Community Transit, and Sound Transit light rail. The data generally represented 2016 average conditions. This period reflects the service changes after the opening of the University of Washington Station and related bus transit service changes. Vehicle loads served by routes crossing transit screenlines were found and aggregated into a single screenline existing demand for bus and rail transit.
- **Capacity** – To develop capacity values, existing Metro, Sound Transit, and Community Transit schedules were parsed for route frequency during the peak hour for all routes crossing transit screenlines. The peak frequency was used to determine the number of peak trips individual routes would make during the peak hour. Peak hour trip totals were reduced by one bus to account for the fact that shuttles arrive at stop locations at staggered times throughout the peak hour. (For example, for a route with 10-minute headways, it was assumed that five buses would serve the route in an hour instead of six).

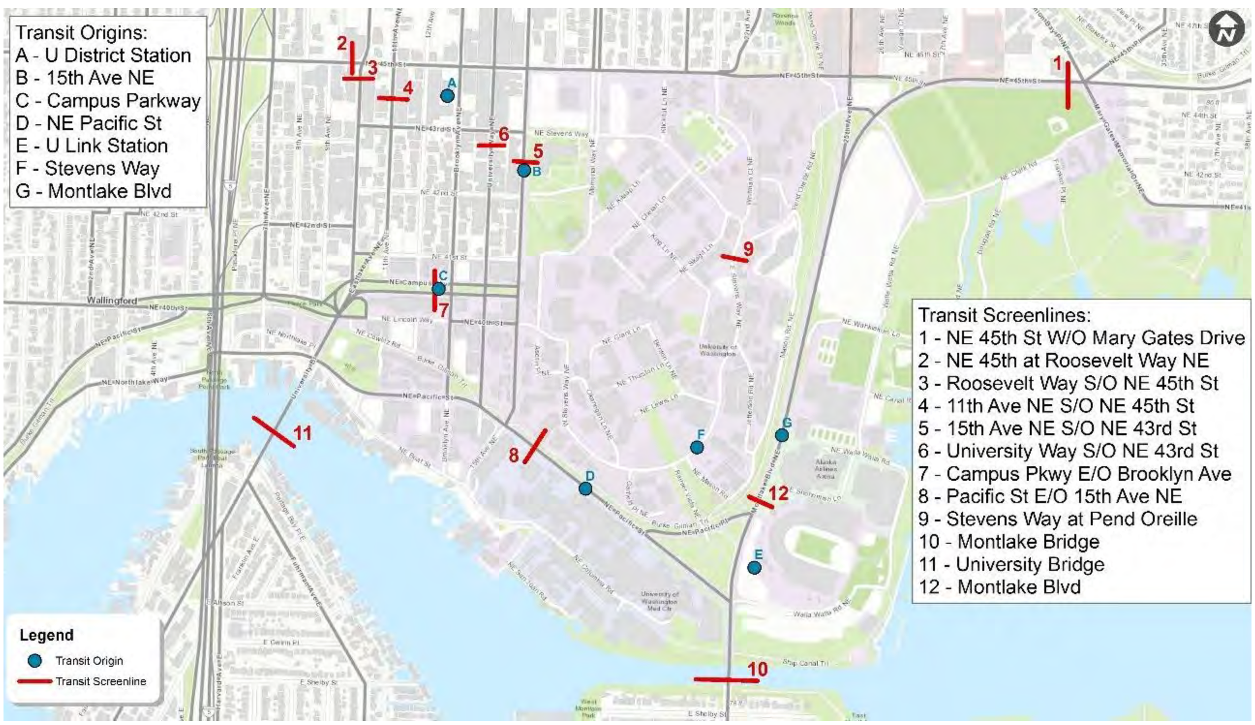


Figure 3.36 Transit Screenlines Analysis Study Area

Total capacity for each route was calculated by using the number of peak trips per hour on individual routes and multiplying that result by an assumed coach/train capacity. Coach capacities varied by vehicle size (40-foot standard bus or 60-foot articulated bus). Assumed transit capacities are shown in Table 3.20. For existing analysis, light rail trains were assumed to consist of three cars arriving with six-minute headways.

Table 3.20
TRANSIT CAPACITY ASSUMPTIONS

Vehicle Type	Assumed Capacity
40-foot Standard Bus	40 passengers
60-foot Articulated Bus	65 passengers
Link	150 passengers per car

Table 3.21
EXISTING TRANSIT SCREENLINE DEMAND AND CAPACITY

Screenline #	Location	Capacity	Demand	Existing D/C
1	NE 45th Street West of Mary Gates Drive	920	584	63%
2	NE 45th Street West of Brooklyn Avenue NE	2,240	641	29%
3	Roosevelt Way NE South of NE 45th Street	520	108	21%
4	11th Avenue NE South of NE 45th Street	520	386	74%
5	15th Avenue NE South of NE 43rd Street	3,600	967	27%
6	University Way NE South of NE 43rd Street	1,040	820	79%
7	Campus Parkway East of Brooklyn Avenue NE	1,810	1,110	61%
8	NE Pacific Street East of 15th Avenue NE	4,400	865	20%
9	Stevens Way NE at Pend Oreille	1,810	1,049	58%
10	Montlake Bridge	2,190	977	45%
11	University Bridge	920	646	70%
	Bus Total	**19,970**	**8,153**	**41%**
Link A	U District Station (opens 2021)	-	-	-
Link B	University of Washington Station	8,550	1,400	16%
	Link Total	**8,550**	**1,400**	**16%**
	Grand Total	**28,520**	**9,553**	**33%**

Table 3.21 shows the existing capacity, demand, and demand-to-capacity (D/C) for each at each of the transit screenlines. D/C rates are found by dividing the demand by capacity. Currently, each of the

screenlines in aggregate has adequate transit capacity to accommodate existing demand. University Way NE ("the Ave") has the highest D/C ratio at 0.79.

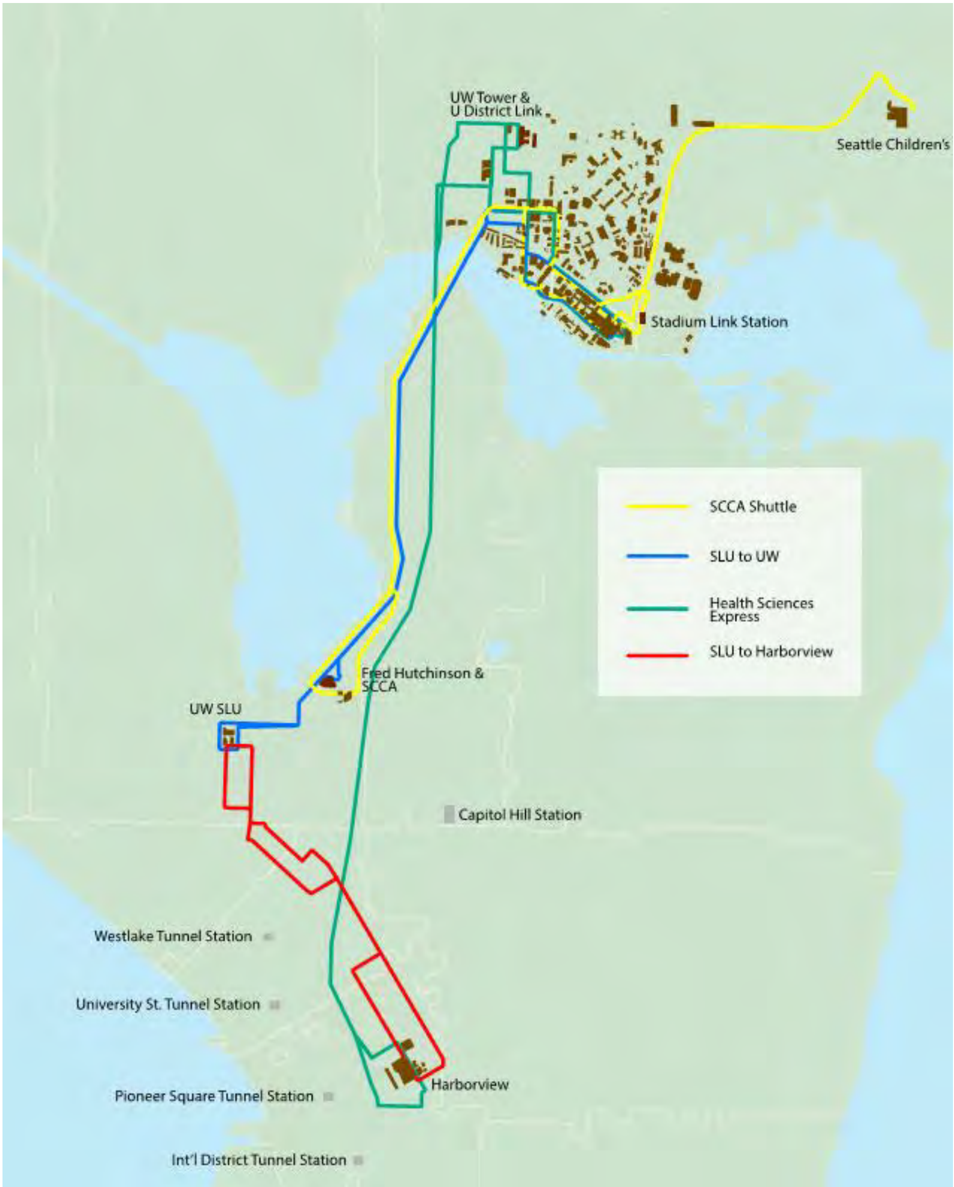
3.4.5 Shuttles Shared Use and Transportation Network Companies

Shuttles serve as auxiliary transit and provide direct connections between University properties. The University of Washington shuttle system extends throughout the campus, providing access to University of Washington Medical Center facilities on campus and in South Lake Union. Shuttles also travel between the U District and Seattle Children's Hospital as well as between Fred Hutchinson and Seattle Cancer Care Alliance (SCCA) in South Lake Union and Harborview Medical Center. The shuttle system is fare free with multiple funding partners.

Shuttle routes include the Health Sciences Express. This service travels between the north and west areas of the campus to south campus and the University of Washington Medical Center, then continues on to the University of Washington Station, University of Washington South Lake Union research facilities, and Harborview Medical Center. University of Washington shuttle services also include NightRide and Dial-a-Ride vehicles.

An additional shuttle route sponsored by Seattle Children's Hospital travels from Children's Hospital to the University of Washington Station and then to the South Lake Union research facilities.

Although fare free, primary customers for the University of Washington shuttles can include patients or others conducting business between facilities. Passenger volumes are modest in comparison to the university population. Although shuttles are far reaching to Seattle Children's Hospital, South Lake Union, and Harborview Medical Center, routes are indirect, infrequent, and do not serve all areas of the U District. The shuttle systems serving the campus are shown in Figure 3.37.



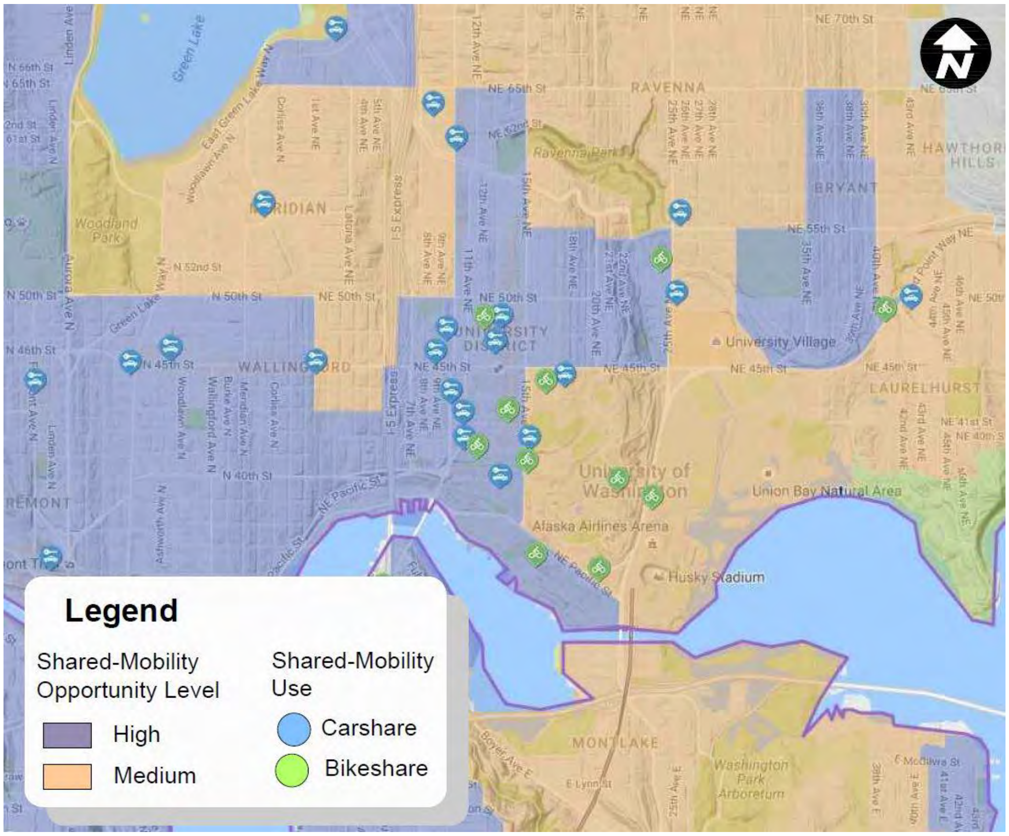
Source: UWTS, 2016

Figure 3.37 Existing University of Washington Shuttle Routes

Private car sharing services, such as Car2Go, ReachNow, and Zipcar, as well as Transportation Network Companies (TNCs), including Uber and Lyft, operate in the study area, providing an alternative to private automobile use and parking for campus communities. In the future, these car sharing and livery services can provide options for first and last mile access to transit. The Shared Use Mobility Center provides data and mapping of shared use opportunities (http://maps.sharedusemobilitycenter.org/sumc/).

This web tool also suggests that areas around the campus have relatively high shared use mobility opportunities. It should be noted that data from TNCs is not available. Maintaining passenger loading areas throughout the campus in the future can help foster use of TNCs. The web tool offers information on bikeshare facilities; however, the Pronto Cycle Share program was discontinued in March 2017.

Figure 3.38 shows car- and bikeshare facilities in and around campus.



Source: Shared Use Mobility Center, Transpo Group, 2016 prior to Pronto closure (http://maps.sharedusemobilitycenter.org/sumc/)

Figure 3.38 Shared Use Mobility in the Area and Shared Mobility Opportunity Level

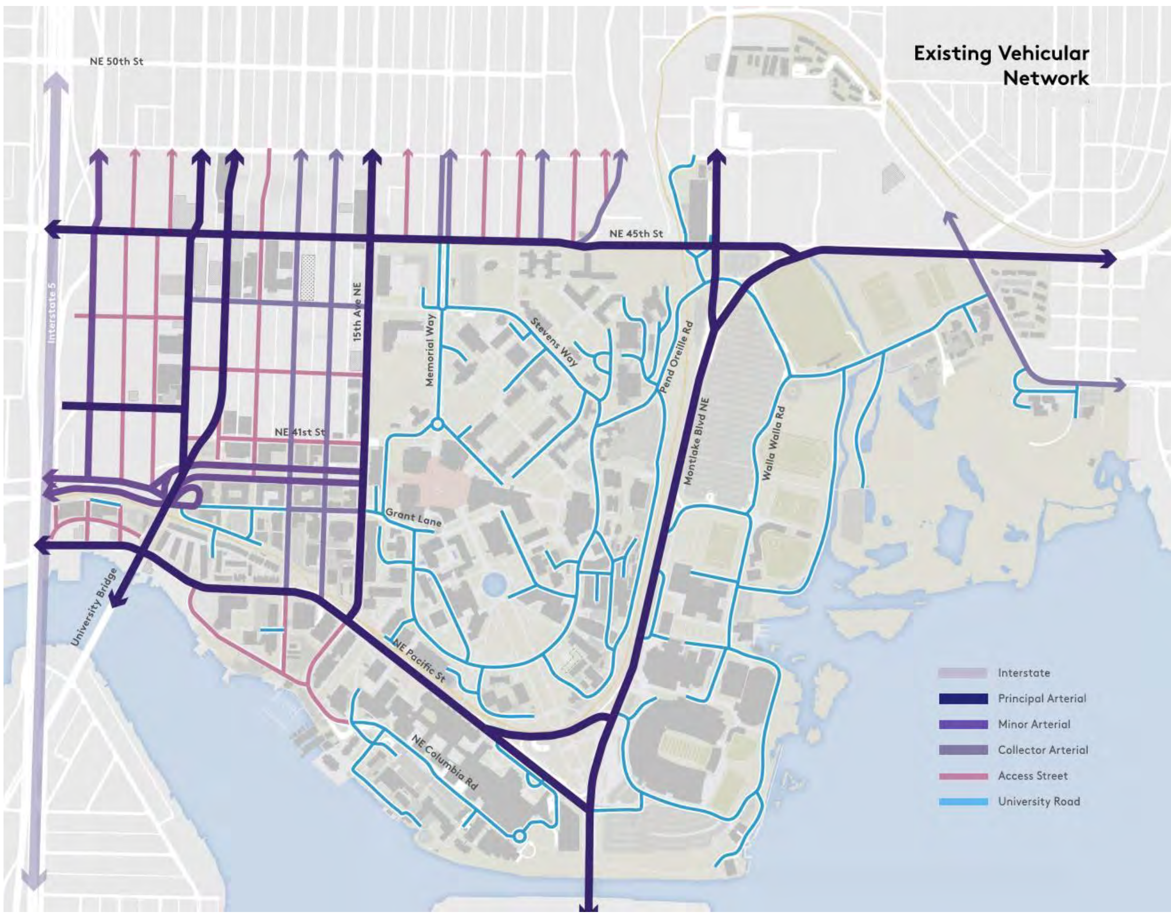
3.5 VEHICLE

As shown in Table 3.2, approximately 13,000 people access the campus using SOVs. Of these trips, 3,720 are students, 3,539 are faculty, and 5,683 are staff. Additionally, more than 4,000 individuals access the campus using carpools.

3.5.1 Street System

The street system in the vicinity of the University of Washington campus is comprised of different classes of roadways serving multiple functions. City of Seattle roadways are classified as principal arterials, minor arterials, collector arterials, and local access streets. Roadways owned by the University of Washington do not have separate functional classifications but are generally similar in nature to local access streets. Broader regional access to the University of Washington campus is provided via Interstate 5 (I-5) to the west and State Route 520 (SR 520) to the south. Connections between the campus and these regional facilities are generally provided via principal arterials.

Figure 3.39 shows the City of Seattle's street classifications in the study area and identifies University of Washington-owned roads. Table 3.22 summarizes the characteristics of major corridors within the study area (principal and minor arterials) including each roadway's functional classification, speed limit, number of lanes, parking, and general characteristics of non-motorized facilities. The City also designates streets with freight, pedestrian, and transit classifications. The current classifications for the streets included in the study area are also noted in Table 3.22.



Source: Sasaki Architects, July 2017 CMP

Figure 3.39 Arterial Classifications in the Study Area

Table 3.22
STUDY AREA EXISTING ROADWAY NETWORK SUMMARY

Street	Classification	Posted Speed Limit	Number of Travel Lanes	Parking	Sidewalks and Bicycle Facilities
NE 50th Street	Principal Arterial[1] Minor Transit	25 mph	2 travel lanes in each direction	No	Sidewalks on both sides
NE 45th Street	Principal Arterial Major/Minor Transit	25 mph	1–3 EB travel lanes; 2-3 WB travel lanes	No	Sidewalks on both sides; sharrows
NE 42nd Street	Principal Arterial/Access Street Major Transit	25 mph	1 travel lane in each direction	Intermittent both sides; peak hour restrictions	Sidewalks on both sides
NE Northlake Way	Collector Arterial	25 mph	1–2 travel lanes in each direction	Intermittent both sides; peak hour restrictions	Sidewalks mostly on both sides but intermittent
NE Pacific Street	Principal Arterial Principal/Minor Transit	25 mph	1–2 travel lanes in each direction; EB bus only near Montlake Boulevard NE	No	Sidewalks on both sides west of 15th Avenue NE; south side only east of 15th Avenue NE
Roosevelt Way NE	Principal Arterial Major Transit	25 mph	2 one-way southbound travel lanes	Intermittent paid	Sidewalks on both sides; cycle track
11th Avenue	Principal Arterial Major Transit	25 mph	2–3 one-way northbound travel lanes	Intermittent paid & time limited	Sidewalks on both sides
Eastlake Avenue NE	Principal Arterial Major Transit	25 mph	2 travel lanes in each direction	No	Sidewalks & bicycle lanes on both sides
15th Avenue NE	Principal Arterial Principal Transit	25 mph	2 travel lanes in each direction	Intermittent paid	Sidewalks on both sides
Montlake Boulevard NE	Principal Arterial Principal/Major Transit	25–35 mph	2–3 travel lanes in each direction	No	Sidewalks on both sides south of NE Pacific Place; east side only north of NE Pacific Place
25th Avenue NE	Principal Arterial Minor Transit	25 mph	2 travel lanes in each direction	No	Sidewalks on both sides
NE 40th Street	Minor Arterial/Collector Minor/Local Transit	25–30 mph	1 travel lane in each direction	Intermittent paid	Sidewalks on both sides
NE Campus Way	Minor Arterial Major Transit	25 mph	2 travel lanes in each direction	Intermittent paid	Sidewalks on both sides

EB = Eastbound, NEB = Northeast-bound, NWB = Northwest-bound, SWB = Southwest bound, WB = Westbound
1. NE 50th Street is a collector arterial east of 15th Avenue.

Source: Transpo Group, 2016

In addition to functional classification, the City also classifies roadways as Major and Minor Truck Streets and Green Streets. Neighborhood Green Streets are roadways where pedestrian circulation and open space are prioritized over other transportation uses through design and operational features. Within the study area, NE Pacific Street, NE 45th Street, and Montlake Boulevard south of NE Pacific Street are designated as Minor Truck routes. Several Neighborhood Green Streets are located within the study area and include Brooklyn Avenue NE, NE 43rd Street, and NE 42nd Street. Routes designated for trucks in the Freight Master Plan are shown in Figure 3.49 in Section 3.5.5, Existing Service Routes and Loading.

3.5.2 Traffic Volumes

Performance Measures

Six measures of effectiveness were analyzed to evaluate the impact of the campus growth on the surrounding transportation network:

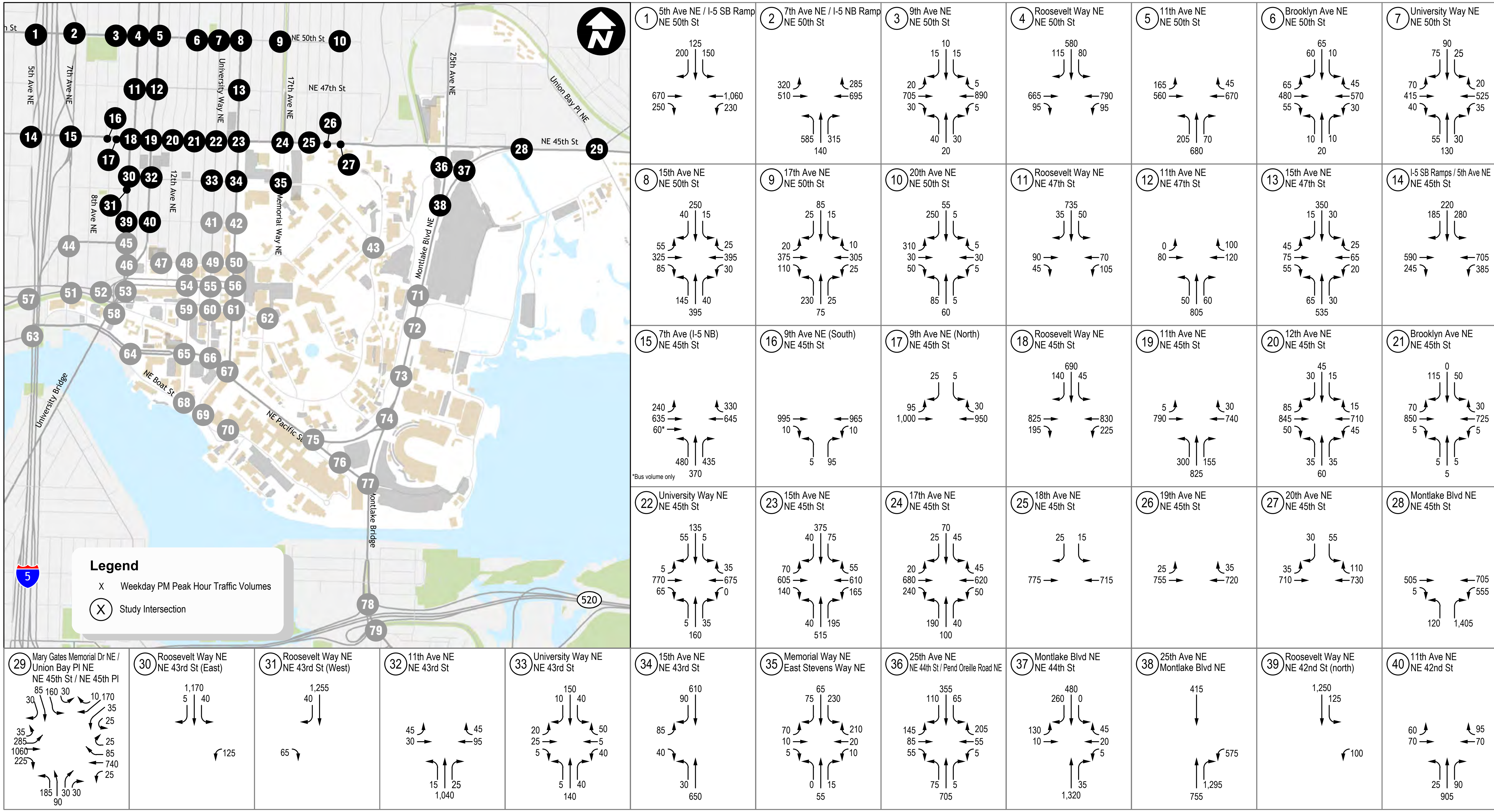
- Intersection operational level of service for intersection located in the primary and secondary impact area
- Arterial Corridor Operations
- Screenline Volumes
- Cordon Volumes
- Caps are set as 1990 trip levels to the University District and University (MIO)
- Freight Corridor Impact

Primary Impact Zone

Traffic data were obtained for all study area intersections from counts commissioned by Transpo Group and performed by Quality Counts between October and November 2015. The existing weekday PM peak hour traffic volumes are shown in Figure 3.40 and Figure 3.41 below.

In the vicinity of the University of Washington campus, and typical of their functional classification, vehicular traffic volumes are greatest along the principal arterial roadways. West of the campus, the highest volume roadway is the Roosevelt Way NE-11th Avenue NE couplet, which currently serves a combined 1,700 to 2,700 vehicles during the weekday PM peak hour. The remaining principal arterials serve the following vehicular volumes during the weekday PM peak commute period:

- NE 45th Street - between 1,500 to 2,000 vehicles per hour
- NE 50th Street - approximately 1,500 vehicles per hour
- 15th Avenue NE - approximately 1,100 to 1,400 vehicles per hour



Existing (2015) (Intersections 1-40) Weekday PM Peak Hour Traffic Volumes

University of Washington 2018 Campus Master Plan

FIGURE **3.40**

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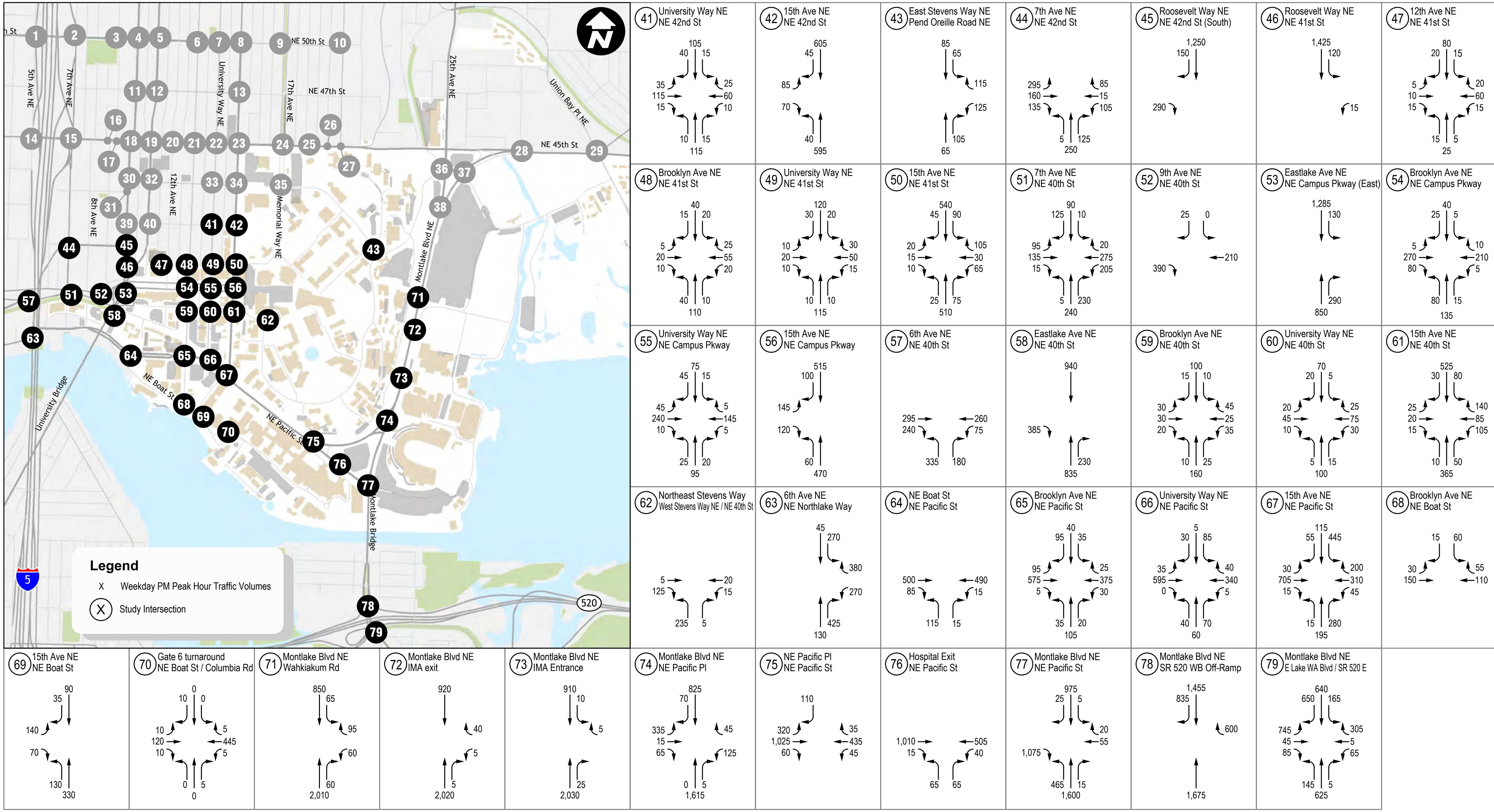

Existing (2015) (Intersections 41-79) Weekday PM Peak Hour Traffic Volumes

University of Washington 2018 Campus Master Plan

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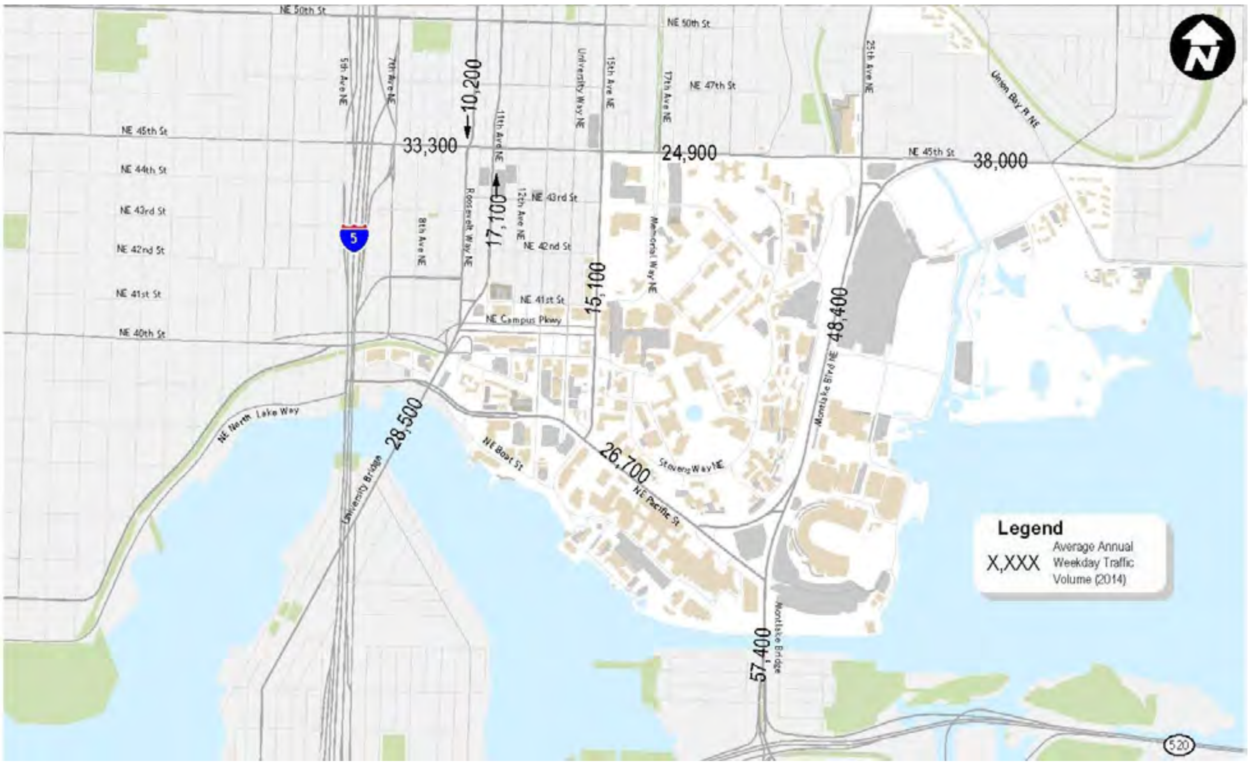
The remaining principal arterials in the vicinity of the University of Washington campus include NE Pacific Street and Montlake Boulevard NE. NE Pacific Street serves approximately 1,400 to 1,800 vehicles during the weekday PM peak hour. Montlake Boulevard serves approximately 3,000 vehicles per hour north of NE Pacific Street and 4,000 to 4,500 vehicles per hour near the SR 520 interchange. Existing (2014) Average Annual Weekday Traffic (AAWDT) volumes are shown in Figure 3.42. AAWDT volumes are based on SDOT's Traffic Flow Data and Maps. Year 2014 data is the most recent available.



Source: SDOT Traffic Flow Data and Maps

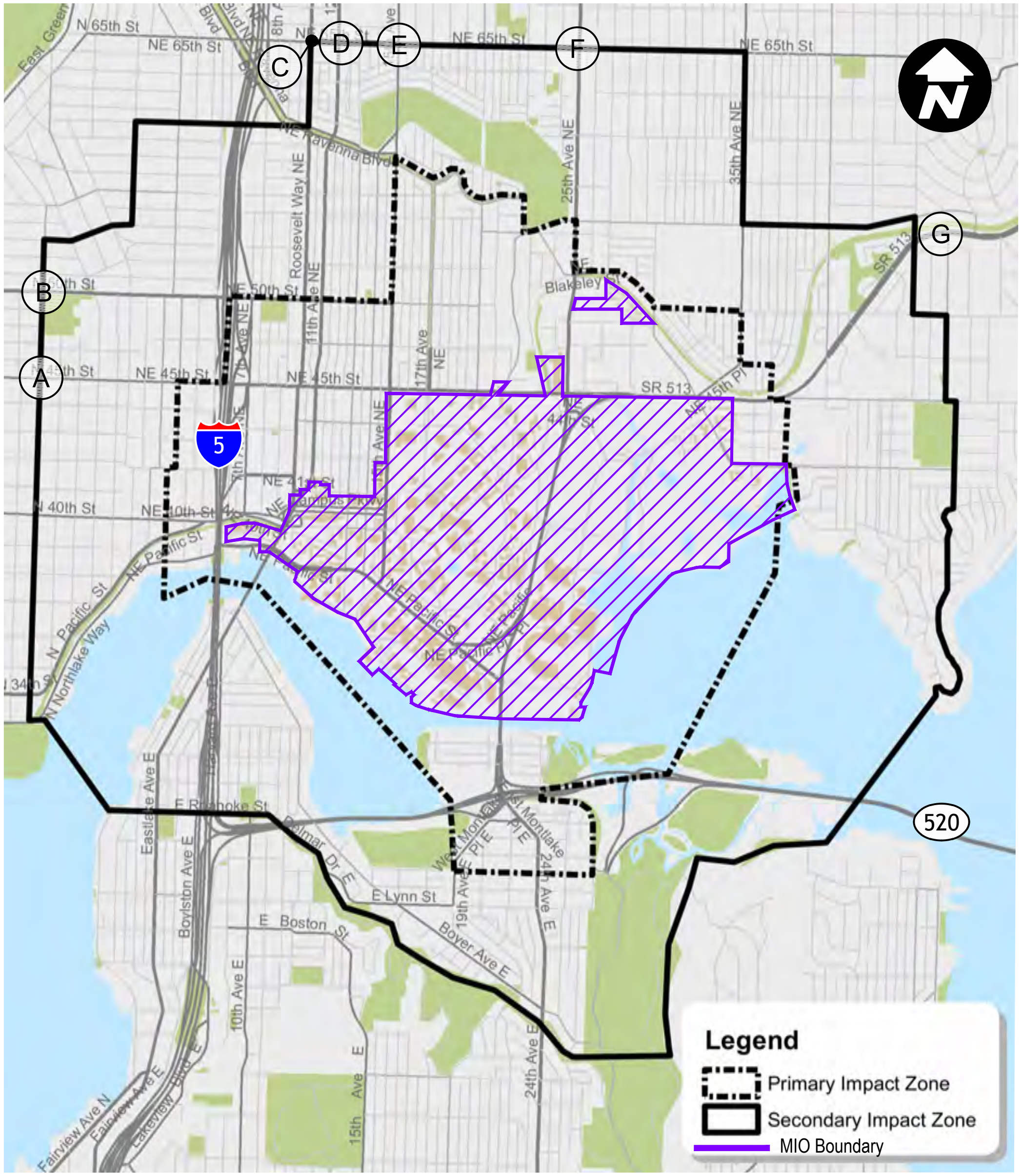
Figure 3.42 Average Annual Weekday Traffic Volumes in the Study Area

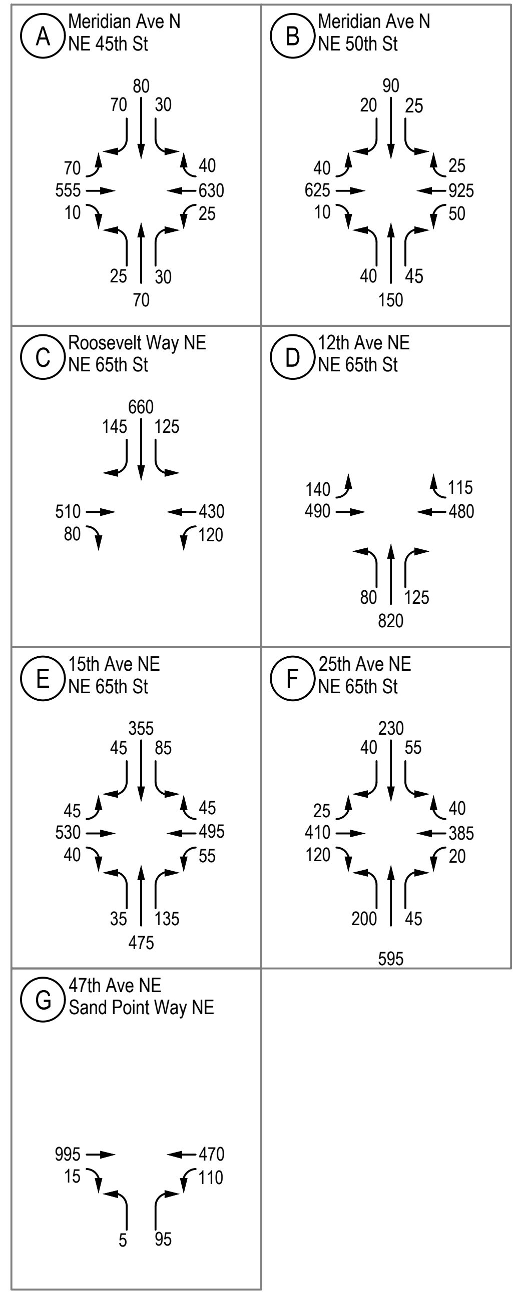
As shown in Figure 3.42, Montlake Boulevard NE carries the highest AAWDT volumes of the study area corridors included in this analysis.

Secondary Impact Zone

In addition to the 79 study intersections analyzed in the primary impact zone, 7 study intersections located in the secondary impact zone were included for analysis and comparison of PM peak hour volume growth. Traffic volumes in the secondary impact zone are anticipated to dissipate resulting in lesser impacts as compared to the primary impact zone. As such, a smaller study area was selected in for analysis in the secondary impact zone. The study intersections located in the secondary impact zone are shown in Figure 3.43 and include:

A. Meridian Avenue N/NE 45th Street
B. Meridian Avenue N/NE 50th Street
C. Roosevelt Way NE/NE 65th Street
D. 12th Avenue NE/NE 65th Street
E. 15th Avenue NE/NE 65th Street
F. 25th Avenue NE/NE 65th Street
G. 47th Avenue NE/Sand Point Way NE





Existing (2017) Secondary Impact Zone Weekday PM Peak Hour Traffic Volumes

University of Washington 2018 Campus Master Plan

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3.5.3 Traffic Operations Performance

Detailed methods for evaluation of traffic operations are described in Appendix B: Methods and Assumptions. Arterial LOS was evaluated along seven corridors within the primary impact zone and include:

- 11th Avenue NE, Northbound (NE Campus Parkway to NE 50th Street)
- 15th Avenue NE, Northbound/Southbound (NE Boat Street to NE 50th Street)
- Montlake Boulevard E, Northbound/Southbound (E Lake Washington Boulevard to NE 45th Street)
- NE 45th Street, Eastbound/Westbound (5th Avenue NE to Union Bay Place NE)
- NE Pacific Street (NE Northlake Way), Eastbound/Westbound (6th Avenue NE to Montlake Boulevard E)
- Roosevelt Way NE, Southbound (NE Campus Parkway to NE 50th Street)
- Stevens Way NE, Eastbound/Westbound (15th Avenue NE to 25th Avenue NE)

Arterial performance is based on the average vehicle speed and the arterial class of the corridor. The average speed along the corridor includes vehicle travel time and the delay from traffic signals. Signal delay for arterial LOS is based on Synchro 9 methodology. The arterial class is determined by Synchro 9 based on the speed limit and intersection spacing of the corridor.

Intersection Operations – Primary Impact Zone

As part of the intersection operations analysis, signal timing, and phasing information was obtained from the SDOT. Lane geometrics and traffic control were confirmed through a review of aerial images from 2015 and field visits. Because of peak period on-street parking restrictions, the functional lane geometry changed at some of the study area intersections between the weekday AM and PM peak periods. At intersections with transit lanes (for example Pacific Avenue), modifications were made to the Synchro 9 model to account for the bus lanes. The intersection levels of service also considered pedestrian volumes, bicycle volumes, heavy vehicle volumes, and intersection peaking characteristics from the traffic volume counts. Note that operations at the intersections of Brooklyn Avenue NE/ NE Campus Parkway and University Way NE/ NE Campus Parkway were reviewed as either separate or combined intersections, considering the overall weighted average delay. This method of analysis was performed to account for the current configuration of the intersections. Additional discussion regarding these intersections is included in Appendix B: Methods and Assumptions.

As illustrated in Figure 3.44, all primary impact zone study area intersections currently operate at LOS D or better, with the exception of the following 11 intersections that operate at LOS E or F:

- 16. 9th Avenue NE (South)/NE 45th Street
- 31. Roosevelt Way NE/NE 43rd Street (West)
- 46. Roosevelt Way NE/NE 41st Street
- 47. 12th Avenue NE/NE 41st Street
- 49. University Way NE/NE 41st Street
- 51. 7th Avenue NE/NE 40th Street
- 57. 6th Avenue NE/NE 40th Street
- 71. Montlake Boulevard NE/Wahkiakum Road
- 78. Montlake Boulevard NE/SR 520 WB Off-Ramp
- 79. Montlake Boulevard NE/E Lake Washington Boulevard/SR 520 EB Ramps

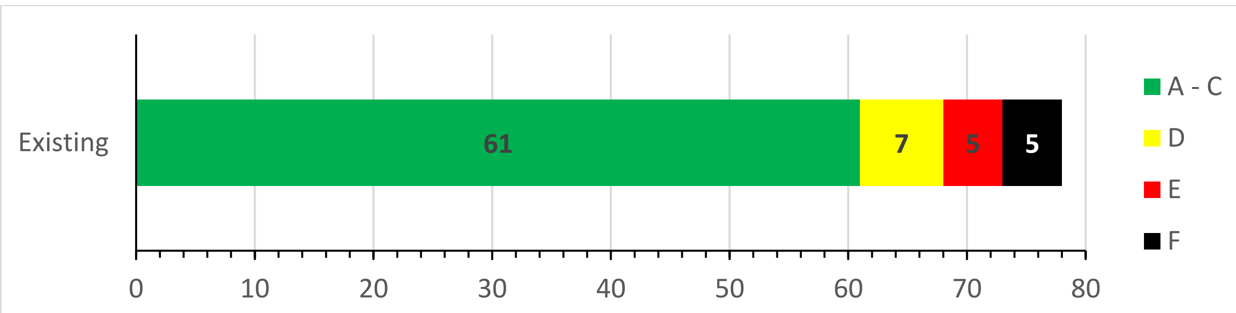
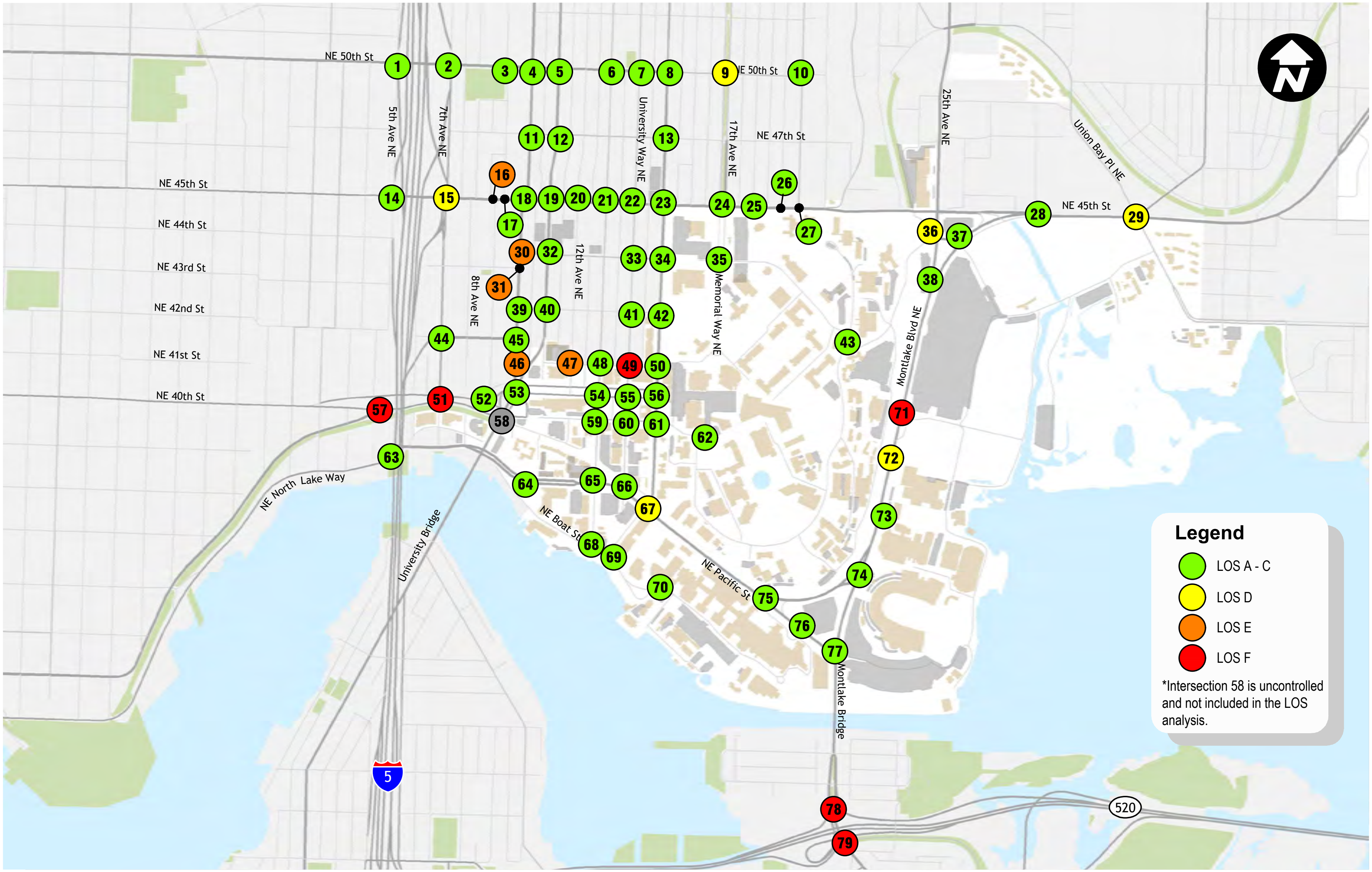


Figure 3.44 Existing (2016) Weekday PM Peak Intersection Level of Service Summary

Intersection LOS is shown for all study area intersections in Figure 3.45 for the weekday PM peak hour. Intersection summary tables for LOS results are included in Appendix C. Detailed level of service worksheets are also included in Appendix C.



Existing (2015) Weekday PM Peak Hour Traffic Operations

University of Washington 2018 Campus Master Plan

FIGURE 3.45

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Intersection Operations – Secondary Impact Zone

Weekday PM peak hour intersection traffic operations under existing conditions at seven intersections in the Secondary Impact Zone are shown in Table 3.23**.** Complete intersection LOS summaries are provided in Appendix C.

Table 3.23
INTERSECTION LEVEL OF SERVICE SUMMARY – SECONDARY IMPACT ZONE

Intersection	Existing	
	LOS[1]	Delay[2]
A. Meridian Avenue N/N 45th Street	B	11
B. Meridian Avenue N/N 50th Street	B	13
C. Roosevelt Way NE/NE 65th Street	D	41
D. 12th Avenue NE/NE 65th Street	C	23
E. 15th Avenue NE/NE 65th Street	F	133
F. 25th Avenue NE/NE 65th Street	E	78
G. 47th Avenue NE/Sand Point Way NE	C	19

*Volume exceeds capacity and Synchro could not calculate the delay.
1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

As shown in Table 3.23, the secondary impact zone intersections are anticipated to operate at LOS D or above with the exception of the 15th Avenue NE/ NE 65th Street and 25th Avenue NE/ NE 65th Street intersections. The 15th Avenue NE/ NE 65th Street intersection is anticipated to operate at LOS F with approximately 133 seconds of delay, and the 25th Avenue NE/ NE 65th Street intersection is anticipated to operate at LOS E with approximately 78 seconds of delay.

Arterial Operations

Route performance along key corridors was evaluated within the study area to provide an additional level of analysis regarding the overall operations of the roadway network. Methods for calculating arterial operations is described in Appendix B: Methods and Assumptions. Table 3.24 provides a summary of the existing calibrated travel times and average speeds. Detailed data, including travel times measured in the field, existing uncalibrated travel times from the Synchro model, and the resulting adjustment factor can be found in Appendix C.

Table 3.24
EXISTING FACTORED WEEKDAY PM PEAK HOUR ARTERIAL TRAVEL TIMES AND SPEEDS

Corridor	Existing Factored Model Output[1]	
	Travel Time (m:ss)[2]	Average Speed (mph)
11th Avenue NE between NE Campus Parkway and NE 50th Street		
Northbound	4:19	8.5
15th Avenue NE between NE Boat Street and NE 50th Street		
Northbound	6:58	8.2
Southbound	6:03	9.4
Montlake Boulevard NE between E Lake Washington Boulevard and NE 45th Street		
Northbound	5:32	14.0
Southbound	11:01	8.0
NE 45th Street between 5th Avenue NE and Union Bay Place NE		
Eastbound	8:25	11.7
Westbound	7:51	12.0
NE Pacific Street (NE Northlake Way) between 6th Avenue NE and Montlake Boulevard E		
Eastbound	4:32	15.9
Westbound	3:30	20.6
Roosevelt Way NE between NE Campus Parkway and NE 50th Street		
Southbound	5:21	14.4
Stevens Way NE between 15th Avenue NE and 25th Avenue NE		
Eastbound	7:38	3.2
Westbound	5:26	2.7

1. Existing factored model output is Synchro output data that has been adjusted to account for existing field measurements and takes into account operational impacts such as mid-block crosswalks and parking maneuvers.
2. m:ss = minutes and seconds.

As shown, the weekday PM peak travel speeds took into account free-flow travel times and intersection-related delay. Overall, the travel times and speeds indicated existing congestion in both directions, but particularly so in the southbound direction along Montlake Boulevard E. With future traffic growth, all directional travel times would increase and travel speeds would decrease.

The arterial analysis was performed using the Synchro 9 software and determined arterial LOS based on travel speed between points. The results are summarized in Table 3.25**.** Detailed arterial LOS calculations are included in Appendix C. Traffic conditions can be worse when extreme congestion on I-5 and SR 520 constrains access onto the freeway.

Table 3.25
EXISTING PM PEAK ARTERIAL LEVEL OF SERVICE SUMMARY

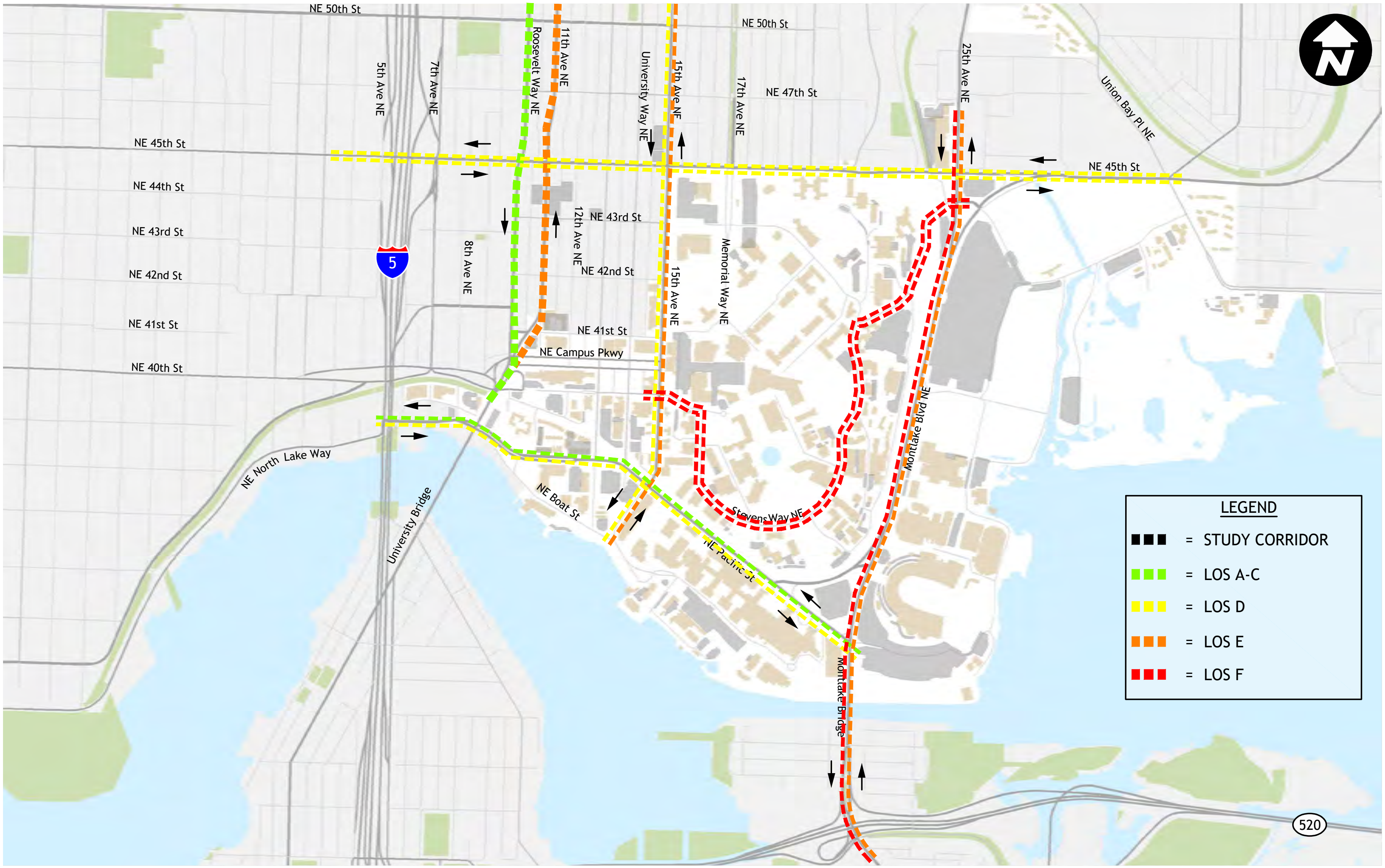
Corridor	Existing PM Peak Hour	
	Level of Service (LOS)	Speed (mph)
NE 45th Street, Eastbound (5th Avenue NE to Union Bay Place NE)	D	11.7
NE 45th Street, Westbound (5th Avenue NE to Union Bay Place NE)	D	12.0
NE Pacific Street (NE Northlake Way), Eastbound (6th Avenue NE to Montlake Boulevard E)	D	15.9
NE Pacific Street (NE Northlake Way), Westbound (6th Avenue NE to Montlake Boulevard E)	C	20.6
11th Avenue NE, Northbound (NE Campus Parkway to NE 50th Street)	E	8.5
Roosevelt Way NE, Southbound (NE Campus Parkway to NE 50th Street)	C	14.4
15th Avenue NE, Northbound (NE Boat Street to NE 50th Street)	E	8.2
15th Avenue NE, Southbound (NE Boat Street to NE 50th Street)	D	9.4
Montlake Boulevard NE, Northbound (E Lake Washington Boulevard to NE 45th Street)	E	14.0
Montlake Boulevard NE, Southbound (E Lake Washington Boulevard to NE 45th Street)	F	8.0
Stevens Way NE, Eastbound (15th Avenue NE to 25th Avenue NE)	F	3.2
Stevens Way NE, Westbound (15th Avenue NE to 25th Avenue NE)	F	2.7

Source: Transpo Group, 2016

As shown in Figure 3.46, three arterials analyzed currently operate at either LOS D or better during the weekday PM peak hour conditions. The following arterials operate at LOS E or worse:

- 11th Avenue NE in the northbound direction (LOS E)
- 15th Avenue NE northbound (LOS E)
- Montlake Boulevard NE northbound (LOS E)
- Montlake Boulevard NE southbound (LOS F)
- Stevens Way NE eastbound (LOS F)
- Stevens Way NE westbound (LOS F)

These arterials serve as the main routes to/from I-5 and the University of Washington campus and experience congestion during the peak periods resulting from heavy commuting traffic volumes.



Existing (2015) Weekday PM Peak Hour Corridor Traffic Operations

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Screenline Analysis: Primary Impact Zone

The following section describes the analysis completed for two designated screenlines within the study area, consistent with the City of Seattle's Transportation Concurrency system. Screenlines are imaginary lines across which the number of passing vehicles is counted. In this study, screenlines were selected to count vehicle traffic entering and exiting the University of Washington primary and secondary impact zones. As part of the 2035 Comprehensive Plan (City of Seattle, 2016), two screenlines were identified within the vicinity of the University of Washington, as shown in Figure 3.47. Screenline 5.16 is an east-west screenline, measuring north-south travel, and extending along the ship canal to include the University and Montlake bridges. Screenline 13.13 is a north-south screenline, measuring east-west travel, and extending east of I-5 between NE Pacific Street and NE Ravenna Boulevard.

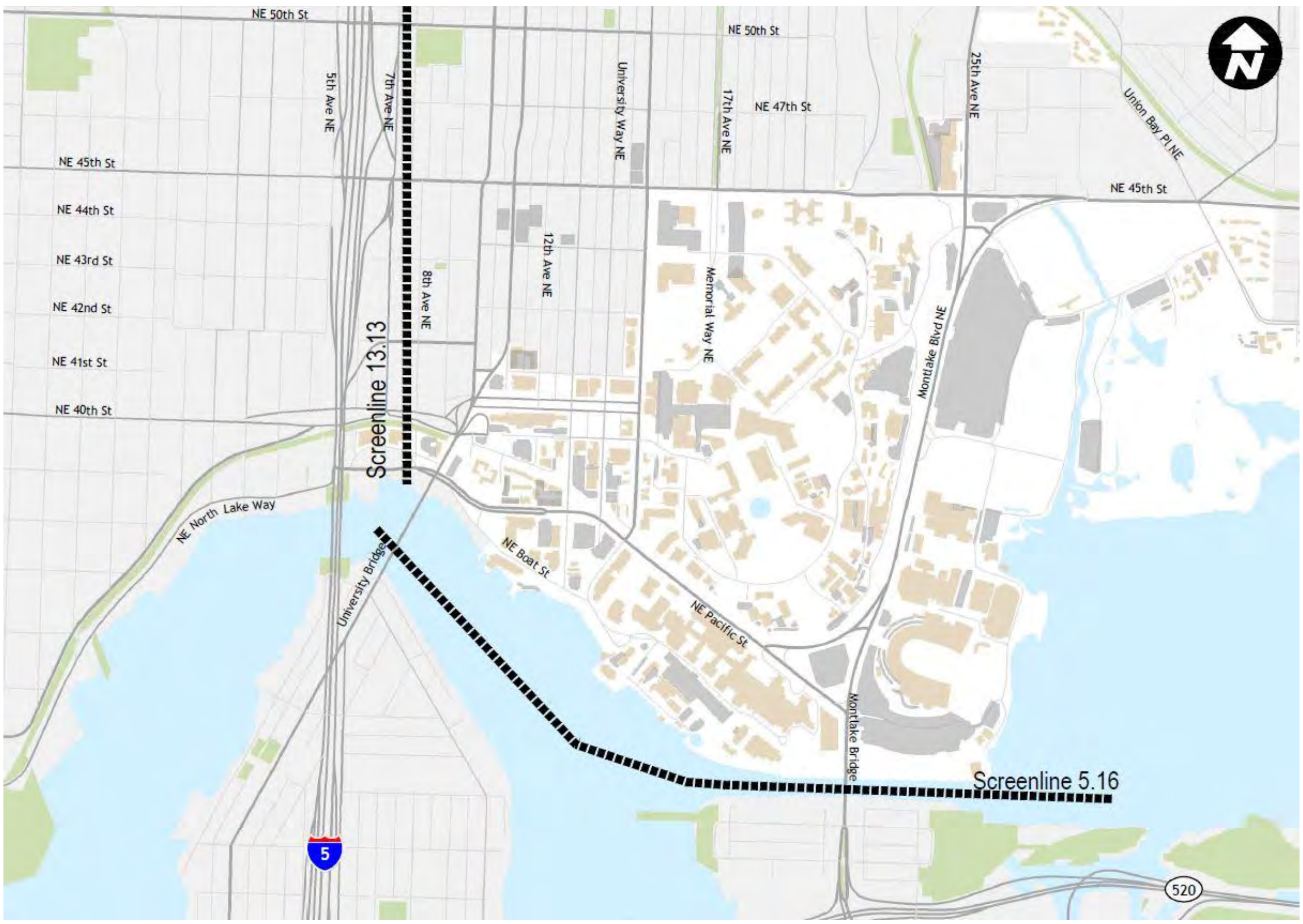


Figure 3.47 Study Area Screenlines

The screenline analysis included volume-to-capacity (V/C) calculations for the vehicles traversing the screenlines using existing (2015) traffic volumes and roadway capacity estimates. Existing roadway capacity estimates are shown in Table 3.26 below.

Table 3.26
ROADWAY CAPACITY ASSUMPTIONS

Roadway Description	Capacity (per direction, per hour)
Two-lane street	800
Four-lane street	1,600
Six-lane street	2,400
Two-lane street with frequent buses	750
Four-lane street with frequent buses	1,450
Six-lane street with frequent buses	2,150

Source: NACTO and Transpo Group, 2016

LOS standards for the screenline analysis were based on the V/C ratio of a screenline. As described in the Seattle Comprehensive Plan Update EIS, the LOS standard V/C ratio for Screenline 5.16 and Screenline 13.13 were 1.20 and 1.00, respectively. The existing conditions screenline analysis is included in Table 3.27. Detailed screenline volumes and V/C calculations are included in Appendix C.

Table 3.27
EXISTING SCREENLINE ANALYSIS

Screenline	Screenline Volume	Capacity	V/C	LOS Standard V/C
5.16 – Ship Canal, University and Montlake Bridges				
Northbound	3,340	3,850	0.87	1.20
Southbound	3,615	3,850	0.94	1.20
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard				
Eastbound	3,245	6,100	0.53	1.00
Westbound	3,620	6,100	0.59	1.00

Source: NACTO, Seattle Comprehensive Plan Update EIS, and Transpo Group, 2016

As shown in Table 3.27, all existing screenline V/C ratios meet the acceptable LOS standard.

3.5.4 Collision History

Recent collision records were reviewed within the study area to identify existing traffic safety issues at the study intersections. The most recent three-year summary of collision data from the SDOT and WSDOT is for the period between January 1, 2012 and December 31, 2014. Collisions were summarized at study locations for vehicle, bicycle, and pedestrian modes. Locations with an average of three or more collisions per year and total three-year bicycle and pedestrian collisions are summarized in Table 3.28.

SDOT annually reviews the previous year's collisions within the City and creates a list of "high collision locations" (HCLs) that are monitored or reviewed in the next year. The review screens the previous year collisions for signalized intersections with 10 or more collisions in a year, unsignalized intersections with five or more collisions, and locations with five or more pedestrian or bicycle collisions in the previous three years. SDOT's Draft Candidate Locations for 2015 HCL Reviews shows the following locations in the study area:

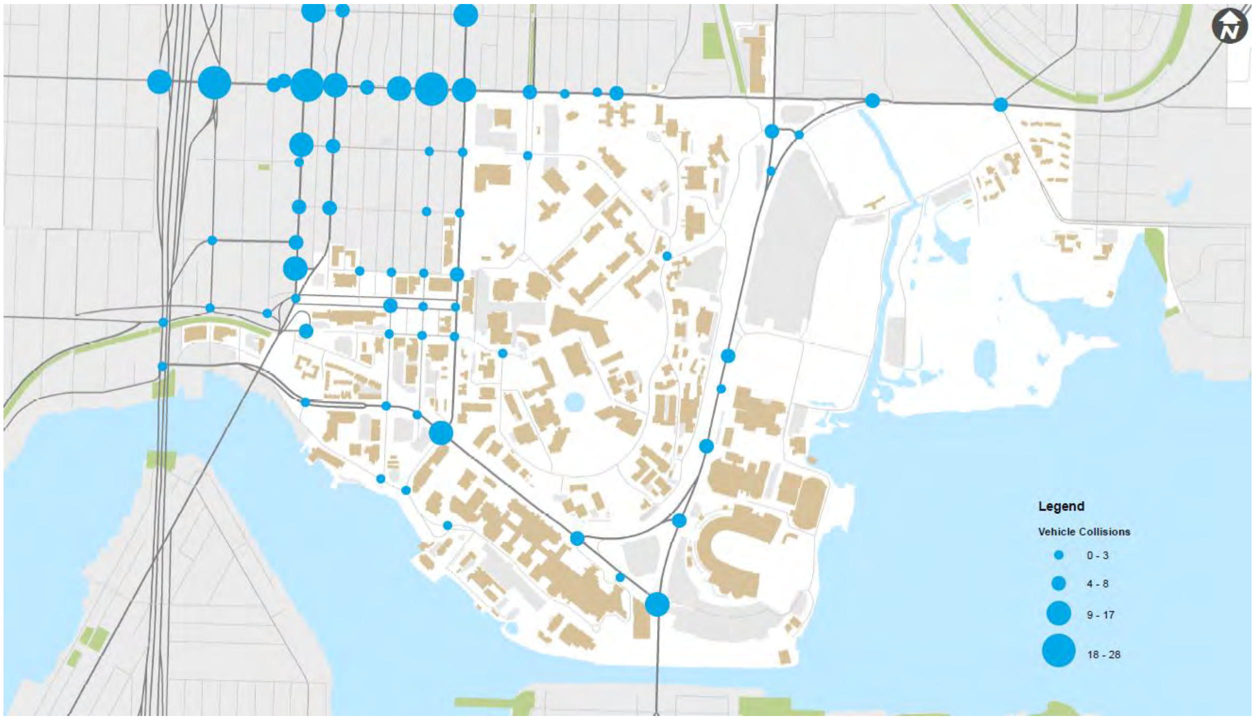
- **Roosevelt Way NE / NE 45th Street**: This intersection experienced nine collisions in 2014. Additionally, this location had four pedestrian collisions during the three-year period. A repaving project in 2015 included improvements for pedestrians.
- **Brooklyn Avenue NE / NE 45th Street:** This location experienced seven pedestrian collisions during the three-year period. The City monitored this location in 2013.
- **Brooklyn Avenue NE / NE 50th Street:** This location experienced four pedestrian collisions during the three-year period.

Table 3.28
THREE-YEAR COLLISION SUMMARY

Location	Three-Year Total (1/2012–12/2014)			
	Pedestrian/ Bicycle	Total Fatalities	Total Vehicle Collisions	Annual Average Vehicle Collisions
7th Avenue (I-5 NB) / NE 45th Street	3	0	18	6
Roosevelt Way NE / NE 45th Street	5	0	18	6
Brooklyn Avenue NE / NE 50th Street	4	0	17	5.7
11th Avenue NE / NE 50th Street	5	0	15	5
Roosevelt Way NE / NE 50th Street	3	0	14	4.7
15th Avenue NE / NE 50th Street	1	0	14	4.7
University Way NE / NE 45th Street	2	0	14	4.7
University Way NE / NE 50th Street	5	0	13	4.3
Brooklyn Avenue NE / NE 45th Street	6	0	12	4
9th Avenue NE / NE 50th Street	1	0	10	3.3
Roosevelt Way NE / NE 41st Street	2	0	10	3.3
Montlake Boulevard NE / E Lake WA Boulevard / SR 520 E	2	0	10	3.3
7th Avenue NE / I-5 NB Ramp / NE 50th Street	2	0	9	3
Montlake Boulevard NE / NE Pacific Street	1	0	9	3

Source: SDOT and WSDOT

A hotspot analysis showing the number of collisions within the study area is shown in Figure 3.48.



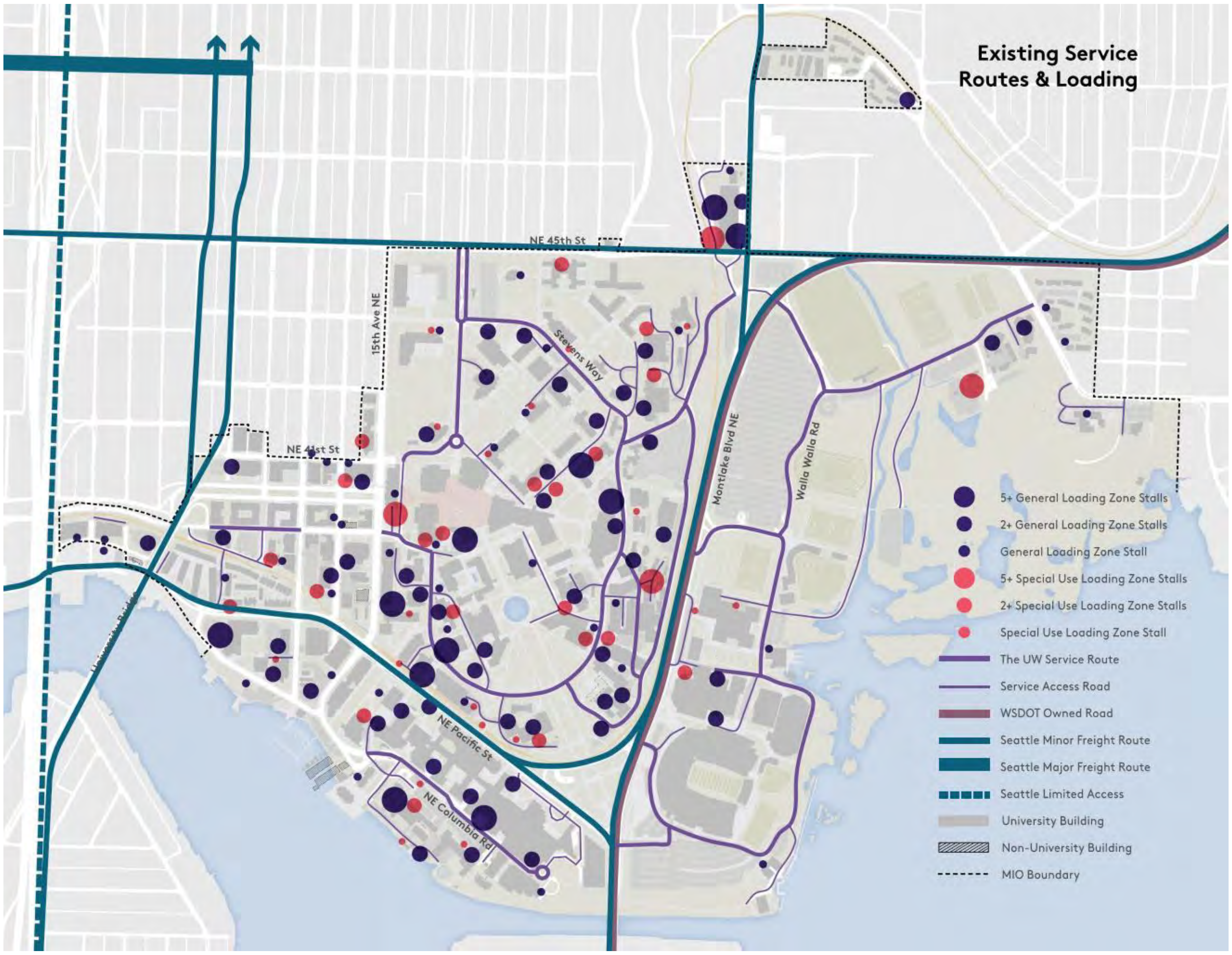
Source: Transpo Group, 2016

Figure 3.48 Intersection Vehicle Collision Summary

3.5.5 Service/Freight Routes

Freight deliveries occur throughout campus directly from shippers to individual buildings. Interdepartmental deliveries also occur. Figure 3.49 highlights the existing loading zones, service access roads, and University of Washington service routes. Loading zones include on-street loading zones and dedicated off-street zones. Vehicles may access the site using one of the many arterials such as NE 45th Street, Montlake Boulevard NE, or any of the local streets depending on the nature of the delivery. Figure 3.49 also shows designated Major and Minor Truck Streets as designated in the City of Seattle Freight Master Plan. The Freight Master Plan identifies areas where freight vehicles are constrained on the freight network. The plan identifies a bottleneck on Montlake Boulevard at the Hec Edmondson Bridge which has a low clearance of 12’ 6” clearance and is subject to bridge strikes. It also notes congestion areas and a medium high bottleneck for freight on Montlake Boulevard along the campus edge.

Freight Master Plan: The City of Seattle has published their first Freight Master Plan in 2016. The plan includes a network of designated Major and Minor Truck Streets, limited access facilities, and first/last mile connectors that are planned and designed to accommodate truck movements.



Source: Sasaki Architects, July 2017 CMP

Figure 3.49 Existing Service Routes and Loading

Table 3.29 summarizes heavy vehicle percentages along Stevens Way NE, based on 2015 PM peak hour turning movement counts. Two study intersections are located along Stevens Way NE, at the W Stevens Way NE/ NE Grant Lane and E Stevens Way NE/ Pend Oreille Road NE intersections. PM peak hour heavy vehicle percentages are shown in the Table 3.29 below.

Table 3.29
STEVENS WAY NE HEAVY VEHICLE PERCENTAGES

Intersection	Heavy Vehicle Percentage by Movement			
	NB	SB	EB	WB
W Stevens Way NE/ NE Grant Lane/ NE 40th Street	14.3%	0%	11.0%	0%
E Stevens Way NE/ Pend Oreille Road NE	8.4%	16.7%	0%	5.9%

Source: Transpo Group, 2016

3.5.6 Parking

The University of Washington parking is managed by UWTS. Parking on campus consists largely of paid permit parking on weekdays between 6 am and 9 pm, and on Saturday from 7 am to noon. Students, faculty, and staff generally have pre-assigned parking areas; visitors are allocated to open spaces on a day-by-day basis depending on demand characteristics. Complimentary parking is available on weekdays after 9 pm until 6 am, on Saturdays from noon until 6 am, and all day on Sundays and holidays. The methodology for evaluating parking demands as well as the supply of existing and future conditions is described in the Appendix B: Methods and Assumptions. Parking supply and demand are described below for existing University of Washington conditions.

Parking Supply

The existing CMP limits on-campus parking to a maximum of 12,300 spaces. This parking space cap does not include service and load zones, cycle spaces, accessory off-campus leased spaces, and spaces associated with student housing. Of the 12,545 spaces on campus, the University currently reports 10,667 spaces in the most recent parking cap calculation for City-University Agreement (CUA) compliance, which is well below the allowed cap of 12,300 spaces the University could supply.

Parking Supply Cap: The University of Washington has an obligation as part of the City-University Agreement (CUA) with the City of Seattle to meet parking caps. The current on-campus parking limit is 12,300 spaces.

This parking analysis focuses on the current cap supply because this captures the supply available to accommodate campus growth.

Figure 3.50 shows existing campus parking supply by sector.

Source: UWTS

Figure 3.50 Existing Campus Cap Parking Supply by Sector

Parking Demand

Peak parking demand at the University of Washington occurs midday between 11 am and 2 pm, which is consistent with class and work schedules as well as visitors coming to/from campus. Table 3.30 summarizes the existing 2015 peak parking demand counts for the campus. This parking demand analysis included spaces used within the cap parking supply. It also considered other parking demand scenarios that may utilize cap supply in the future such as current on-street parking or other areas of campus not subject to the parking cap. Visitor parking demand was also included as part of the analysis.

Table 3.30
EXISTING PEAK PARKING DEMAND BY POPULATION

	Vehicles Parked[1]			
	Students[2]	**Faculty[2]**	**Staff[2]**	**Total**
On-Campus[2]	1,844	1,090	3,786	6,720
On-Street[2]	134	49	93	276
Total	**1,978**	**1,139**	**3,879**	**6,996**

1. Based on University of Washington 2015 parking counts, which includes visitor parking. Peak parking demand occurs during the weekday midday period.
2. Demand by population and parking destinations based on a three-year average of the University of Washington Transportation Surveys (2012, 2013, and 2014).

Source: Transpo Group, 2016

As shown in the table, the peak on-campus parking demand for this analysis was approximately 6,700 vehicles, which resulted in approximately 63 percent of the cap parking supply being utilized. In addition, parking occurs on-street within the MIO and surrounding areas. However, there are some on-street parking restrictions such as time limits and restricted parking zones. Based on commute trip survey responses, it was estimated that, during the weekday peak period, approximately 275 vehicles associated with the University of Washington were parked on-street. Field observations indicated that on-street parking was generally full in the vicinity of the University of Washington.

The on-campus parking demand and utilization was also reviewed by sector to provide context on where parking was occurring (see Table 3.31). Allocation of existing parking demand by sector was based on the University of Washington parking counts that indicated where vehicles were parked on-campus.

Table 3.31
EXISTING SUPPLY AND WEEKDAY PEAK PARKING DEMAND BY SECTOR

Sector	Campus Parking Supply		Existing Parking Demand[1]	
	No. Lots	Cap Supply	Demand (vehicles)	% Utilization
West	26	1,524	1,428	94%
South	12	1,161	1,139	98%
Central	42	3,129	2,689	86%
East	21	4,853	1,464	30%
Total	**101**	**10,667**	**6,720**	**63%**

Source: Transpo Group, 2016

1. Based on 2015 parking counts conducted by University of Washington Transportation Services, which includes visitor parking. Peak parking demand occurs during the weekday midday period.

As shown in the table, the West and South Campus sector parking areas are the most highly utilized on the campus. This utilization is reflective of the majority of activity occurring at the University of Washington Medical Center and student and staff parking permits being allocated to the South and Central Campus sectors. The East Campus sector is the farthest from most of the academic buildings, therefore, parking is less utilized during the peak midday period. The South and West Campus sectors experience the highest level of peak utilization at 93 to 98 percent, which is effectively at or near capacity when the search for parking is considered. In fact, some of the reported demand in the West Campus sector is likely parking that would occur in the South Campus sector, if it were not redirected to available parking in West Campus garages and lots.

Parking utilization for each campus lot is included in the following tables. As shown in the campus parking supply and demand by sector, this data is also based on the 2015 parking counts conducted by UWTS.

Table 3.32
EXISTING WEEKDAY PARKING UTILIZATION BY LOT – WEST CAMPUS

Lot Number	2015 Parking Percent Utilization
W08 (Lander)	0%
W10	82%
W11	77%
W12	93%
W13	82%
W20	65%

Lot Number	2015 Parking Percent Utilization
W21	82%
W22	53%
W23	34%
PBG Total	91%
W24	0%
W27 (UTC)	78%
W28(Gravel)	0%
W29	65%
W32	78%
W33	78%
W34	0%
W35	89%
W36	87%
W39 (Mercer)	87%
W40 Total	72%
W41	66%
W42	51%
W44 Ben Hall Total	59%
W45 (Building B)	76%
W46 (Building A)	89%
W51	71%
W52	71%
Parrington	100%
Frontage Road (S99)	100%
Spokane Lane (Savery)	100%
Surgery Pavilion	85%
Fisheries Dock	63%
Stadium Garage	0%
Laurel Village (H12)	22%
Gilman Building (4725 30th Avenue NE, Blakely Village - H14)	22%
Nordheim Court	22%
Chelan Lane (Raitt)	100%
Skagit Lane (Music)	76%
Bowman Building (4625 Union Bay Place)	22%

Lot Number	2015 Parking Percent Utilization
4541 Union Bay Place	22%
Radford Court	97%
Roosevelt Clinic 1 (4225 Roosevelt Way NE)	80%
Roosevelt Clinic 2 (4245 Roosevelt Way NE)	80%
Marina 1 (1409 NE Boat Street)	81%
Marina 2 (3537 12th Avenue NE)	59%

Table 3.33
EXISTING WEEKDAY PARKING UTILIZATION BY LOT – SOUTH CAMPUS

Lot Number	2015 Parking Percent Utilization
S1 (Top)	96%
S1 (Middle)	96%
S1 (Bottom)	96%
S1 Total	96%
S5	75%
S6	56%
S7	56%
S8	94%
S9	71%
S12	87%

Table 3.34
EXISTING WEEKDAY PARKING UTILIZATION BY LOT – CENTRAL CAMPUS

Lot Number	2015 Parking Percent Utilization
C01	92%
C02	75%
C03	87%
C04	82%
C05	93%
C06	91%
C07	50%
C08	72%
C09	67%
C10	88%
C12	80%
C14	71%
C15	88%
C17	86%
C19	75%
C20 (Triangle upper)	91%
C21 (Triangle lower)	91%
Triangle Total	91%
C23	75%
N01	89%
N02	0%
N03	94%
N05	92%
N07	67%
N08	76%
N09	88%
N10	30%
N11	13%
N12	29%
N13	96%
N14	30%
N15	51%
N16	91%
N18	87%
N20	83%

Lot Number	2015 Parking Percent Utilization
N21	80%
N22	85%
N24	75%
N25	64%
N26	64%
N28	80%

Table 3.35
EXISTING WEEKDAY PARKING UTILIZATION BY LOT – EAST CAMPUS

Lot Number	2015 Parking Percent Utilization
E1	19%
E2	30%
E3	35%
E4	13%
E6	74%
E8	57%
E8R	75%
E9	68%
E12	37%
E14 (GDR)	17%
E16	35%
E17	33%
E18	35%
E19	98%
E97 (Graves)	57%
E98 (IMA)	57%

Secondary Parking Impacts

Given the cost of parking and the U-PASS program that provides transit passes, there is likely some parking that occurs outside the primary impact zone surrounding the campus. This would include vehicles within transit-served areas with unrestricted parking and then using transit to travel to campus. It is difficult to quantify to what degree parking in neighborhood areas adjacent to the campus is occurring given that the City of Seattle and surrounding areas are well served by transit.

Figure 3.51 shows on-street parking designations within the primary and secondary impact areas based on data available from the City of Seattle. It also indicates areas where on-street parking is unrestricted and subject to casual parking by people going to campus and avoiding paying for parking. This on-street parking in unrestricted areas by campus students, faculty or staff has been noted as a nuisance to property owners although the spaces are open to all.

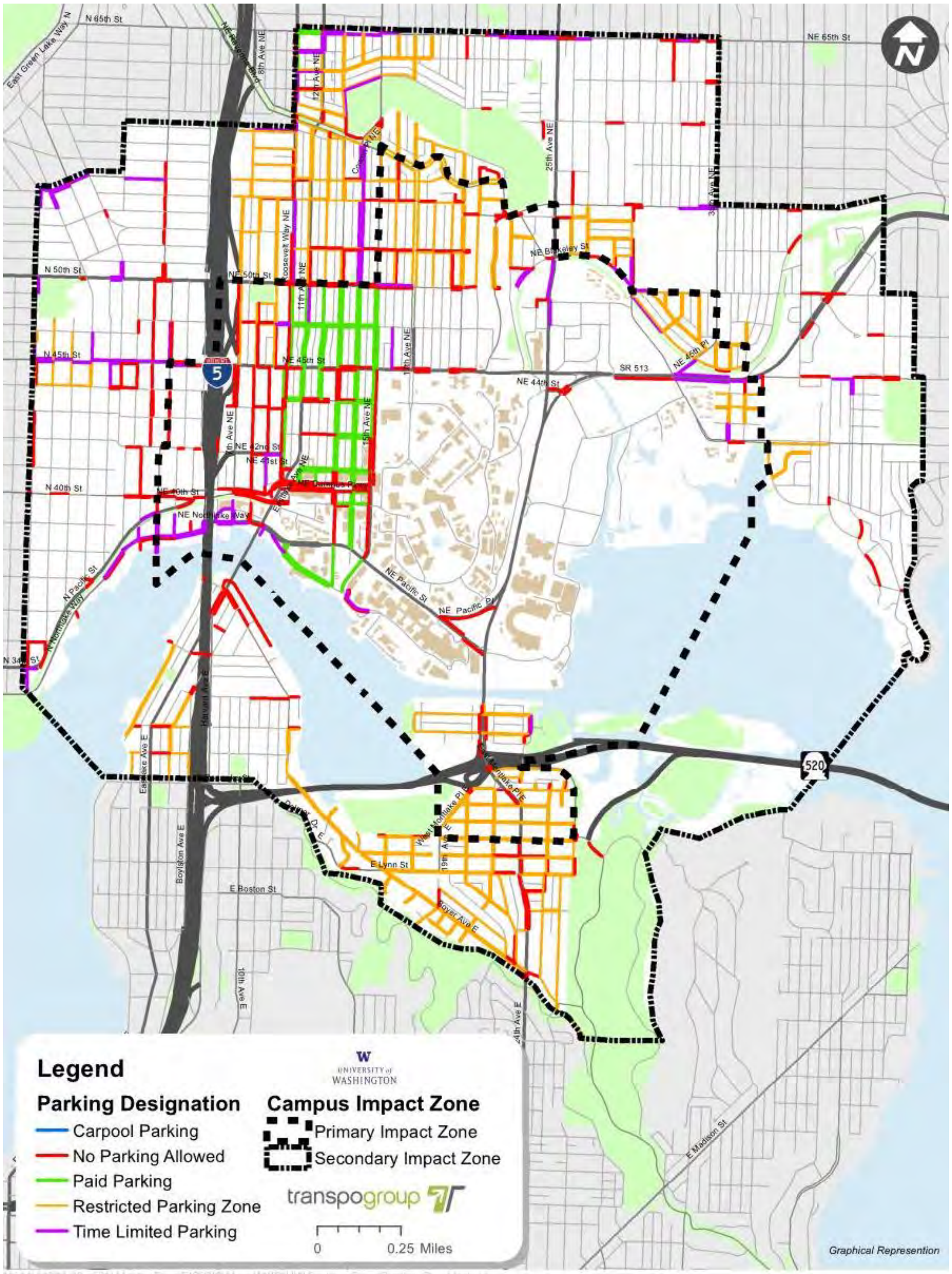


Figure 3.51 Primary and Secondary Impact Zone On-Street Parking Designations

3.5.7 City University Agreement – Trip and Parking Caps

CUA (City-University Agreement): An agreement between the City of Seattle and the University of Washington, that among other things defines various transportation thresholds.

Transportation Management Plan (TMP): A transportation management Plan provides strategies for limiting traffic impacts and promoting active communities by managing vehicle trips and parking, as well as accommodating transit and non-motorized travel modes.

The University of Washington has a continuing obligation as part of the City-University Agreement with the City of Seattle (CUA) to meet vehicle trip and parking caps consistent with traffic levels reached in 1990 unless changed with this new Master Plan. With the introduction of the U-PASS program in 1991, and ongoing attention to U-PASS and other measures identified in the existing Transportation Management Plan (TMP), the University of Washington has maintained compliance with these goals every year since 1991, despite a 35 percent growth rate in campus population.

Vehicle Trips. The University has a program of monitoring, evaluating, and reporting transportation conditions through data collection and survey. Through an annual telephone survey, students, faculty, and staff provide a basis for annual calculations of vehicle trips subject to limits (trip caps), which is reported in the Annual CMP Monitoring Report. Table 3.36 illustrates the 2016 campus surveys of students, faculty, and staff results for peak period travel compared to the trip caps relative to 1990 impact levels.

Table 3.36
TRIP CAP SUMMARY –2016

Location/Peak Period	Trip Cap (vph)	2015	2016
University of Washington Campus			
AM Peak Period Inbound (7–9 am)	7,900	3,997	6,093
PM Peak Period Outbound (3–6 pm)	8,500	7,562	6,351
U District			
AM Peak Period Inbound (7–9 am)	10,100	4,988	7,328
PM Peak Period Outbound (3–6 pm)	10,500	9,329	7,588

Source: UWTS, Annual CMP Monitoring Reports

Figure 3.52 illustrates the historical compliance with the U District trip caps dating back to 2009.

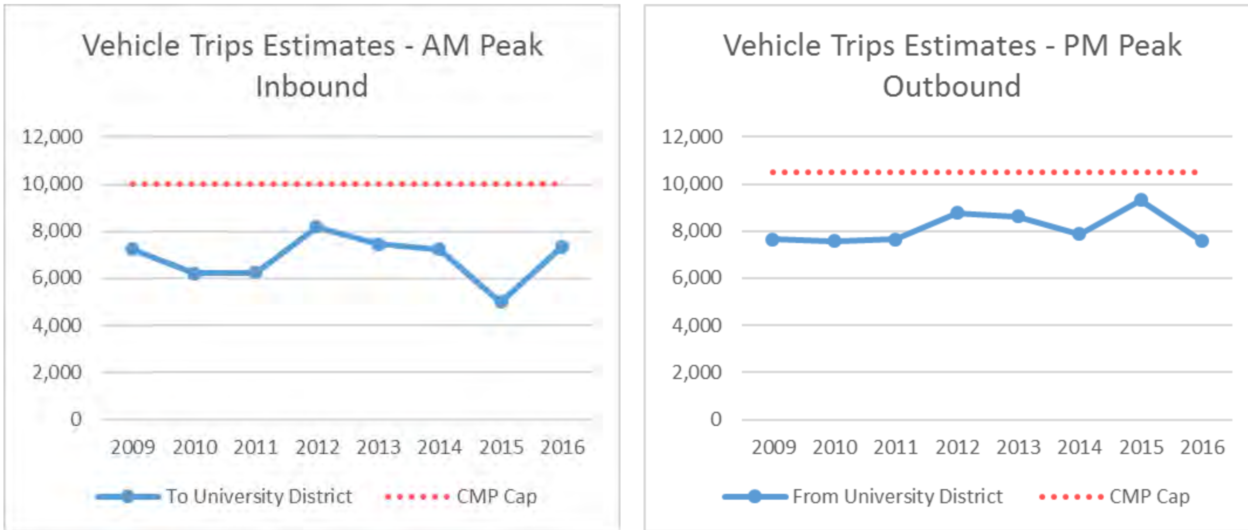


Figure 3.52 Historic AM and PM Trip Cap Summary

Parking Caps. In addition to the trip cap, which is monitored annually, the University has maintained a cap on total parking supply of 12,300 spaces for student, faculty, and staff. This parking cap does not include handicapped or visitor spaces, service and load zones, bicycle spaces, accessory off-campus leased spaces, and spaces associated with student housing. The University of Washington currently has 10,667 spaces included in the most recent parking cap calculation for CUA compliance.

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4 IMPACTS OF NO ACTION

This chapter evaluates all modes of travel and compares existing conditions to the No Action Alternative, defined as operations in the horizon year 2028 with 211,000 gsf of new development.

This chapter describes effects on the transportation system with the No Action Alternative, which assumes buildout of the current 2003 University of Washington Campus Master Plan (CMP). This analysis reflects the impacts associated with approximately 211,000 gross square footage (gsf) of development occurring in the West Campus sector.

This analysis evaluates all modes of travel and compares current transportation system operations noted in Chapter 3, Affected Environment, to operations for a horizon year of 2028, with 211,000 gsf of new development. This No Action Alternative also assumes a proportion of the development assumed in the City of Seattle adopted 2035 Comprehensive Plan and the adopted U District Rezone.

4.1 FUTURE CAMPUS CHARACTERISTICS, POLICY, AND TECHNOLOGY TRENDS

As noted in Chapter 2, Analysis & Methodology Assumptions, several trends and technologies have been considered as emerging factors in travel mode and behavior. While these trends could change transportation, data and information related to each are limited. For the long-range planning horizon, the effects of these policies and technologies were not considered to impact overall transportation results to present a more conservative analysis. Each technology and its impact on the University of Washington are described in Table 4.1.

Table 4.1
EMERGING TRANSPORTATION POLICY AND TECHNOLOGY TRENDS

Technology	Effectiveness and Impact for the UW CMP
Changing Behavior of Millennials – Changing travel behavior among millennials (defined as those reaching adulthood in the early 21st century) suggests this generation may be choosing alternatives to driving alone for travel. A study by the University of Michigan Transportation Research Institute indicates that driver licensing for teens and young adults is declining (for example, the number of 19 year olds with driver's licenses dropped from 87% in 1983 to 69% today[1]).	This trend may result in an overall increased dependence on transit and shared use mobility options in lieu of automobile ownership and may increase demand for transit and other modes, while diminishing drive alone modes. As noted below, increased dependence on shared use mobility is emerging. While overall auto ownership may decline, increased use of autos by Transportation Network Companies (TNCs) may increase and compete with transit.

Technology	Effectiveness and Impact for the UW CMP
Smart Traffic Signal Technology – Traffic signal operations and control are being improved through better real time information, data fusion that improves understanding of travel patterns, and improved operations of traffic signals to better respond to actual traffic patterns and vehicle types. The City of Seattle owns, manages, and operates traffic signals around the city and would take the lead in implementing new adaptive signal control technology.	This technology is being piloted as part of the Next Generation ITS (Intelligent Transportation System) plans of the City of Seattle. This technology can prioritize modes and reduce overall delay for vehicles and be optimized to meet key objectives such as moving people (for example, prioritizing higher occupancy vehicles).
Shared Use Auto Mobility Ride-hail and Transportation Network Companies – While rideshare programs through TNCs like Uber and Lyft and carshare programs like car2go, Zipcar, and ReachNow are popular and gaining in popularity, there are limited data related to the impact or effectiveness in reducing drive alone behavior. Carshare is operated near the University of Washington and is available for student use and is included in the Campus Transportation Management Plan as potential options to support commuting. Parking and passenger loading areas are available throughout the campus and will be assessed as needs arise.	This technology supports student and employee ability to rely less on automobile ownership and reduce drive alone behavior. Effectiveness has been mostly positive when combined with other travel choices such as transit; however, increased circulation and vehicle miles traveled of empty ride-hail/TNC vehicles has not been fully evaluated.
Bikeshare – Pronto, a not-for-profit bikeshare system was implemented in 2015 with mixed success. The program, which included memberships for short- and long-term bicycle rental, ended in March 2017. The future of bikeshare is uncertain; however, there is interest in attempting to create a bikeshare program in the future as bikeshare technology improves. Pronto stations have been located at several locations within and near the campus. As a new bikeshare program emerges, the University would participate in locating and supporting that program.	Emerging technologies where people can use transportation options temporarily, such as bikeshare and rideshare, are being implemented today. Outcomes of these technologies are emerging. While efficacy of bikeshare, specifically Pronto in Seattle, has been mixed and the program ended in March 2017, bikeshare has been identified as desirable by the City if it can be made to be successful in the future.

Technology	Effectiveness and Impact for the UW CMP
Autonomous and Semi-Autonomous Vehicles – There are projections that in the next 20 years, autonomous vehicles may broadly replace the automobile fleet. Semi-autonomous vehicles are already on the market assisting drivers and helping avoid crashes. In the future, these vehicles could be completely autonomous and potentially reduce congestion (vehicles are expected to operate safely with reduced distance between vehicles and potentially higher speeds). Autonomous vehicles have been proposed to operate cleanly (potentially electrically) for a variety of vehicle types (uses, trucks, and passenger vehicles and potentially for shared use), thus further reducing the need for auto ownership. As the technology evolves, autonomous vehicles may become part of the campus fleet to support mobility of people and goods. Additionally, space may be needed to accommodate drop-offs and storage.	This emerging technology has tremendous support and growing advocacy, specifically for its potential to reduce crashes. With added benefits of electrified vehicles and a combination with shared use and driverless mobility, the use and application of autonomous vehicles is expansive. In addition to improving safety, they could: - Increase flexibility of working hours (workers may include commute time in their work time) - Reduce desire for auto ownership - Accommodate rideshare/carshare and vanpooling - Support mobility options for those with disabilities or older drivers - Reduce overall parking needs, including at residences as vehicles are circulating and only need parking in times of low use - Potentially increase vehicle miles traveled - Potentially reduce jobs (drivers) Untested is whether autonomous vehicles could reduce congestion, especially if vehicles are circulating empty or with few passengers and compete with higher-occupancy modes such as transit.

1. http://www.umtri.umich.edu/what-were-doing/news/more-americans-all-ages-spurning-drivers-licenses, 2016.

4.1.1 Future Trip Generation by Mode

The following provides a summary of the methodology used to estimate the pedestrian, bicycle, transit, and vehicle trip generation volumes for all alternatives presented herein. Trip generation for the University of Washington is divided among four categories: students, faculty, staff, and campus visitors. For this analysis, the same methodology was utilized to forecast each category of the trip generation, with the exception of visitors. The technical analysis presented in the following section is based on population projections as enabled by the 211,000 gsf of development.

Trip Generation Methodology

The methodology used to forecast the trip generation for the various transportation modes is based on mode split data for each population group. The basis for the mode split assumes a conservative 2015 mode split of 20% drive alone from the annual survey conducted by the University of Washington Transportation Services (UWTS). The University uses a survey to evaluate the effectiveness of the U-PASS program among students, faculty, and staff. The information is also used to help meet Washington State Commute Trip Reduction (CTR) Law requirements.

The most recent available information provides insight into trends and modes for students, faculty and staff. The 2015 survey reflects a conservative 20% drive alone modes split while a recent survey conducted after the opening of the University of Washington light rail station indicates the drive alone mode split is 17%. The surveys typically capture information from approximately 1,500 to 1,600 students, faculty, and staff, including how many days per week they come to campus; how they get to campus; if they commute, how many people are in the vehicle; how far they live from campus; and the type of parking utilized. Based on the surveys, the following existing characteristics are identified and summarized in Table 4.2. Where available, more data were used, specifically for the time of day and direction of trip (inbound/outbound). Additionally, the survey asks the typical time of arrival and departure. This helps determine if the trip is inside the typical AM (7 to 9 am) and PM (3 to 6 pm) commute periods.

Table 4.2
THREE-YEAR AVERAGE CAMPUS COMMUTE PROFILE[1]

Mode	Students	Faculty	Staff
Transit	44%	25%	42%
Walk	36%	7%	4%
Bicycle	7%	14%	8%
Other	1%	2%	2%
Sub-Total, Non-Vehicular	88%	48%	56%
Vehicle			
Drive Alone	8%	45%	33%
Carpool	4%	7%	11%
Carpool Vehicle Occupancy			
Average Vehicle Occupancy	2.22	2.12	2.15

Source: University of Washington Transit Services surveys.
1. Based on an average of the most recent 3 years (2012, 2013, and 2014) of transportation survey results. Data from 2015 and 2016 not available at time of analysis.

As shown in Table 4.2, a majority (88 percent) of students utilized non-drive alone or carpool modes of transportation to commute to campus. Additionally, approximately 48 percent of faculty and 56 percent of staff utilized non-drive alone or carpool modes.

The daily, AM, and PM peak hour trip generation was developed for existing and future (No Action) conditions. Existing trip generation was estimated to develop the net new trips anticipated to campus, assuming average mode splits. No Action Alternative trip generation was developed first by determining the forecasted student enrollment, faculty, and staff headcount. The No Action trip generation was based on approximately 211,000 gsf of building capacity remaining under the 2003 CMP. A conservative 20 percent cumulative drive alone rate, consistent with the 2015 survey mode split, was utilized for No Action trip generation.

The vehicle trip generation accounts for drive alone vehicles and carpools. Carpools account for the average vehicle occupancy (AVO), as noted above and collected as part of the survey. The resulting vehicle trip generation is summarized in Table 4.3. The daily trip generation by non-vehicle modes is summarized in Table 4.4

In addition to faculty, students, and staff trip generation, other activity from campus visitors also impact the overall traffic levels. Visitor traffic was assumed to equal 10 percent of the net No Action trip generation associated with any of the EIS alternatives.

Table 4.3
ESTIMATED NET NO ACTION ALTERNATIVE VEHICLE TRIPS

Trip Type	Daily Trips	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
No Action Trips	150	35	15	45	20	30	50
Visitors (10%)	15	5	0	5	0	5	5
Total Trips	**165**	**40**	**15**	**50**	**20**	**35**	**55**

Source: Transpo Group, 2016

As shown in Table 4.3, the trip generation associated with the remaining 211,000 gsf under the CMP would be approximately 165 daily trips. Approximately 50 of these trips would occur during the AM peak hour and 55 during the PM peak hour and include visitors. Notably, the PM peak hour would be slightly higher, which aligns with the analysis to address PM peak operations.

Table 4.4
ESTIMATED NET NO ACTION ALTERNATIVE DAILY NON-VEHICLE TRIPS

Trip Type	Transit	Walk	Bicycle	Other
Student	220	290	55	5
Faculty	20	10	20	0
Staff	250	15	20	5
Total Trips	**490**	**315**	**95**	**10**

Source: Transpo Group, 2016

Table 4.4 reflects net No Action Alternative trips based on current daily non-vehicle mode splits for each campus population group. As shown in Table 4.4, under No Action conditions, campus development is anticipated to generate approximately 490 daily transit trips, 315 walk trips, 95 bicycle trips, and 10 other trips.

FINAL

4.2 PEDESTRIANS

4.2.1 Planned Improvements

Pedestrian Master Plan (PMP): The Pedestrian Master Plan identifies priorities for investments to make improvements within the pedestrian realm. An update to the City of Seattle's Pedestrian Master Plan was approved in the Spring 2017.

Planned pedestrian improvements in the University District would work in conjunction with transit additions, including increased King County Metro services and the development of the Sound Transit Link light rail extensions. Green Streets proposed by the City of Seattle to promote a pedestrian environment are identified on NE 43rd Street, NE 42nd Street, and Brooklyn Avenue NE. A proposed future pedestrian network is shown in Source: **Sasaki Architects, July 2017 CMP**

Figure 4.1.

Source: Sasaki Architects, July 2017 CMP

Figure 4.1 Future Pedestrian Circulation

> **Green Streets:** A Green Street is a street right-of-way that, through a variety of design and operational treatments, gives priority to pedestrian circulation and open space over other transportation uses. Treatments may include sidewalk widening, landscaping, traffic calming, and other pedestrian-oriented features. In 2015, the City of Seattle finalized the U District Green Streets Concept Plan.

The University District is included along a 6.1-mile corridor from the Roosevelt District to Downtown Seattle evaluated for high-capacity transit (HCT) within the Seattle Department of Transportation (SDOT) 2016 Transit Master Plan. Improved pedestrian facilities for transit riders would be included along this planned HCT corridor. These facilities would improve pedestrian access along Brooklyn Avenue NE, the Roosevelt Way NE / 11th Avenue NE couplet, and the University Bridge connection to Eastlake Avenue E. Improvements would include pedestrian shelters at transit stops and safe walking routes to the planned light rail stations at Brooklyn Avenue NE and Roosevelt Way NE.

The Move Seattle Strategy shows the Roosevelt to Downtown Complete Street project is planned to be implemented by 2024. Figure below shows an overview of the section of the proposed HCT corridor in the study area.

Source: SDOT 2016 Transit Master Plan

Figure 4.2 Roosevelt to Downtown Complete Street Corridor

Additional planned improvements proposed by Move Seattle include those identified as part of multimodal corridors like Roosevelt Avenue to Eastlake Avenue, 23rd Avenue E Corridor, and NW Market Street to NE 45th Street Improvements. These changes would include improved sidewalks along a corridor connecting to the University of Washington network via Montlake Boulevard. Phase 4 of the 23rd Avenue East Corridor Improvements will reach the transportation network just south of the Montlake Cut.

Move Seattle: A citywide strategic vision and 9-year levy for transportation investments in Seattle.

The SR 520 Bridge Replacement and HOV Program will improve pedestrian connections across the SR 520 corridor and along Montlake Boulevard. This program is fully funded as the "SR 520 Rest of the West" through the Connecting Washington Partners package and will continue to add pedestrian facilities and connections to the Montlake area and existing University of Washington pedestrian network. This includes pedestrian paths and sidewalks connecting to the Burke-Gilman Trail north of the Montlake Cut, as well as connecting to the Washington Park Arboretum Waterfront Trail south of the Cut. In addition to providing safe walking routes, these pedestrian facility additions will connect to existing and planned transit hubs in the U District.

4.2.2 Performance Measures

As noted in Chapter 3, Affected Environment, the following pedestrian-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development within 1/4 Mile of Multifamily Housing
- Proportion of Development within 1/4 Mile of University of Washington Residence Halls
- Quality of Pedestrian Environment
- Pedestrian Screenline Demand and Capacity
- Pedestrian Transit Station/Stop Area LOS

These measures reflect the effectiveness of the pedestrian network in providing safe and easy access to pedestrian destinations, specifically housing, and thereby maintaining a high walk mode choice on campus. Comparisons of No Action conditions to existing conditions is provided for each measure below:

Proportion of Development within 1/4 Mile of Multifamily Housing

Walking makes up nearly one-third of all existing campus-related trips to and from campus. Proximity of campus development to housing is therefore one important measure for assessing the propensity of people to walk. This measure assesses the proximity of the current campus buildings and development to nearby multifamily housing. Similar to existing conditions, with all development occurring in the West Campus sector, 100 percent of the growth would be within 1/4 mile of multifamily housing.

Proportion of Development within 1/4 Mile of University of Washington Residence Halls

Similar to the previous measure, this performance measure assesses the proximity of campus development within walking distance of residence halls, which were identified and then buffered by 1/4 mile. Similar to existing conditions, with all development occurring in the West Campus sector, 100 percent of the growth would be within 1/4 mile of University of Washington residence halls.

Quality of Pedestrian Environment (Primary and Secondary Impact Zones)
The quality of pedestrian travel would largely remain unchanged under the No Action Alternative. Pedestrian travel to/from and around the Link light rail U District Station would be expected to increase. Sound Transit plans to improve pedestrian capacity immediately adjacent to the station along Brooklyn Avenue NE and NE 43rd Street. Improvements to pedestrian travel to/from and across the SR 520 bridge will also be improved with completion of the bridge replacement project.

According to the City of Seattle's Pedestrian Master Plan updated in Spring 2017, additional locations are planned to become Neighborhood Greenways within the primary and secondary impact zones. In addition to the existing 12th Avenue NE Neighborhood Greenway, several new Neighborhood Greenways are proposed within the primary impact zone. These include a southern extension of the 12th Avenue NE Greenway, Walla Walla Road, NE Boat Street from NE Pacific Street to 15th Avenue NE, 20th Avenue NE north of NE 45th Street, NE 47th Street west of 20th Avenue NE, and NE Clark Road. The NE Boat Street Neighborhood Greenway will improve pedestrian connectivity from the Cheshiahud Lake Union Loop to the University of Washington campus. The 20th Avenue NE and NE 47th Street Greenways will increase pedestrian connectivity to the secondary impact zone and connect to planned greenways, including 11th Avenue NE, NE 55th Street, and NE 62nd Street. In the east section of the of the secondary impact zone, new Neighborhood Greenways are planned along 5th Avenue NE, NE 46th Street, and Keystone Place N. Planned improvements on the west side of the secondary impact zone include NE Surber Drive and NE 50th Street.

Pedestrian Screenline Capacity
For the pedestrian screenline capacity analysis, the peak hour demand, capacity, and level of service (LOS) at all at- and above-grade crossing locations along Montlake Boulevard NE, NE Pacific Street, 15th Avenue NE, and NE 45th Street were evaluated. The following sections summarize pedestrian screenline volumes due to background growth and the No Action Alternative.

Background Growth

Conservative background growth estimates were applied to existing peak hour pedestrian counts at all crossing locations to account for an increase in pedestrians on campus between the existing (2016) and (2028) horizon year. A 10 percent background growth increase was applied to existing peak hour pedestrian counts at all crossing locations. In addition, 1,500 additional trips crossing 15th Avenue were applied to the crossings that will be impacted by the 2021 opening of the Link light rail U District Station on Brooklyn Avenue NE. The pedestrian growth from the new light rail station was applied to crossings at the 15th Avenue NE/ NE 41st Street, 15th Avenue NE/ NE 42nd Street, and 15th Avenue NE/ NE 43rd Street intersections. Approximately 1,500 new pedestrians to these crossings was applied during the PM peak hour (60-minute) period to reflect the station opening.

No Action Alternative Growth

Development growth in the No Action Alternative would be focused primarily in the West Campus sector. Therefore, an overall 3 percent increase was applied to each pedestrian crossing located in West Campus, or a total increase of 258 pedestrians in the one-hour peak period. The total No Action Alternative peak hour pedestrian volumes, including background growth, are summarized by screenline in Table 4.5.

Table 4.5
EXISTING (2016) AND NO ACTION ALTERNATIVE (2028) PEAK HOUR PEDESTRIAN VOLUME AND SCREENLINE LEVEL OF SERVICE

Screenline	Existing		No Action Alternative	
	Pedestrian Volume (People/hour)	Level of Service	Pedestrian Volume (People/hour)	Level of Service
Montlake Boulevard NE	12,742	A	14,770	A
NE Pacific Street	3,252	A	3,744	A
15th Avenue NE	7,866	A	12,078	A
NE 45th Street	2,051	A	2,272	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition; Highway Capacity Manual.

As shown in Table 4.5, the No Action Alternative peak hour aggregate pedestrian volumes for all screenlines would be at LOS A.

Pedestrian Transit Stop Space Analysis

The pedestrian transit stop space analysis evaluates the peak hour demand, capacity, and LOS at key transit stops along Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE. The following sections summarize the pedestrian space per person and LOS at these locations within the affected environment.

Background Growth

Conservative background growth estimates were applied to existing peak hour pedestrian counts at all transit stop locations to account for an increase in pedestrians on campus between the existing (2016) and 2028 horizon year. A 10 percent total background increase was applied to existing peak hour pedestrian counts at all transit stop locations to reflect background growth between 2016 and 2028. In addition, a 1,500-person increase was applied only to transit stop locations that will be impacted by the 2021 opening of the U District Station. The growth due to the new light rail station was applied to transit stops at the 15th Avenue NE/ NE Campus Parkway, 15th Avenue NE/ NE 42nd Street, and 15th Avenue NE/ NE 43rd Street intersections.

No Action Alternative Growth

Growth under the No Action Alternative that would occur without the updated CMP would be focused primarily in the West Campus sector. Therefore, an overall 3 percent increase was applied to each transit stop located in West Campus. The total No Action Alternative peak hour pedestrian volumes, including background growth, are summarized by transit stop in Table 4.6.

Table 4.6
EXISTING (2016) AND NO ACTION ALTERNATIVE (2028) PEAK HOUR PEDESTRIAN SPACE AND LEVEL OF SERVICE

Stop Location	Stop ID Number	Existing		No Action Alternative	
		Pedestrian Space (square feet/person)	Level of Service	Pedestrian Space (square feet /person)	Level of Service
NE Pacific St Bay 1	1	49	A	45	A
NE Pacific St Bay 2	2	43	A	39	A
NE Pacific St at 15th Ave NE	3	8	C	8	C
15th Ave NE at Campus Pkwy	4	109	A	62	A
15th Ave NE at NE 42nd St	5	88	A	51	A
15th Ave NE at NE 43rd St	6	49	A	28	A
Montlake Blvd Bay 4	7	43	A	39	A
Montlake Blvd Bay 3	8	120	A	109	A
Stevens Way at Pend Oreille Rd	9	21	A	19	A
Stevens Way at Benton Ln	10	40	A	36	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition; Highway Capacity Manual.

As shown in Table 4.6, the No Action Alternative peak hour aggregate pedestrian volumes for all transit stop locations would be at LOS C or better.

4.3 BICYCLES

4.3.1 Planned Improvements

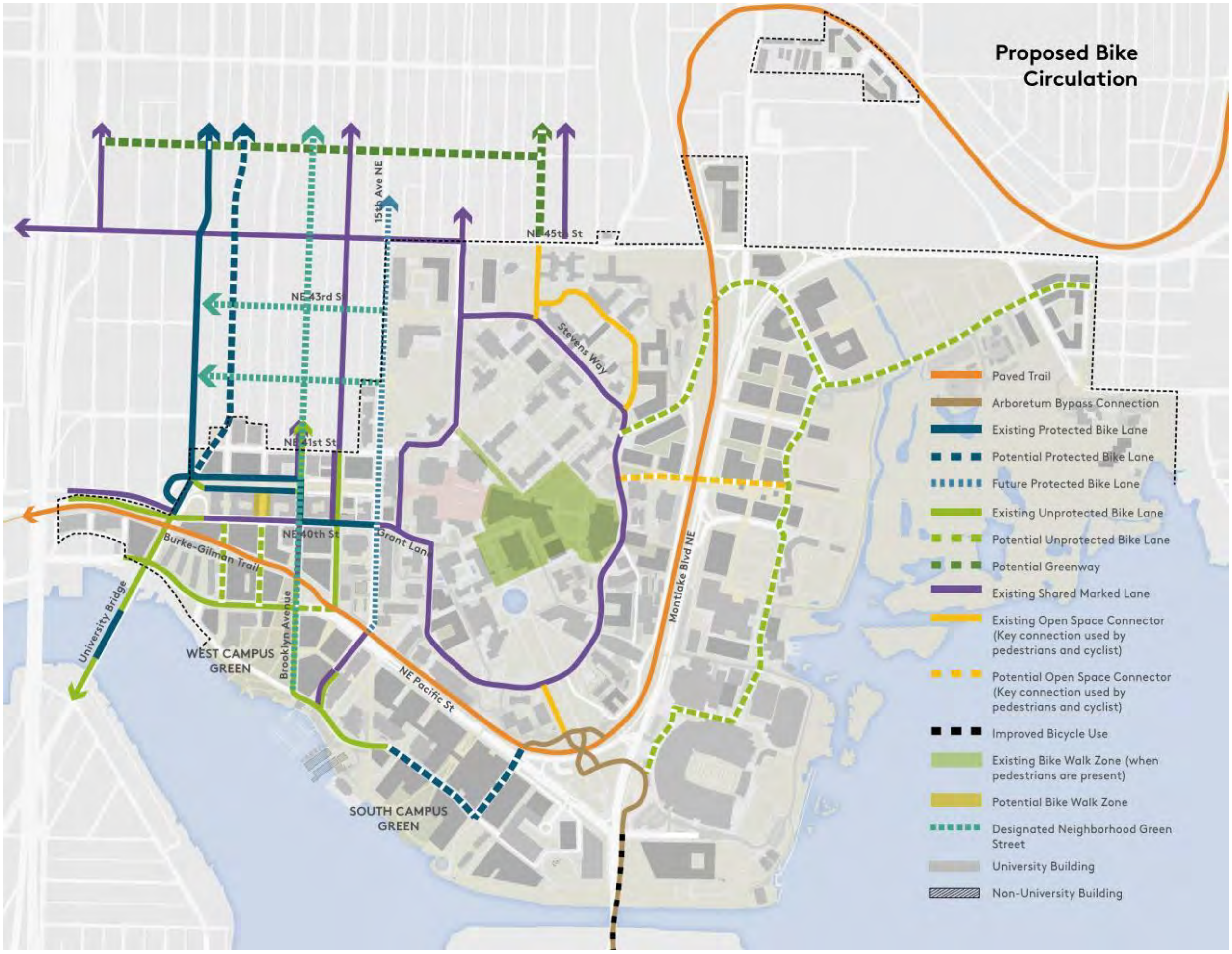
Based on SDOT's 2015–2019 Bicycle Master Plan Implementation Plan, additional protected bicycle lanes and Neighborhood Greenways are planned for implementation between 2015 and 2019. In 2015, planned construction began for protected bicycle lanes along Roosevelt Way NE and NE Campus Parkway throughout the U District. Additional construction is planned in 2018 for protected bicycle lanes along Ravenna Place NE that will connect to the existing U District bicycle network. These improvements will incorporate a block of Brooklyn Avenue NE between NE Campus Parkway and NE 40th Street to integrate with existing campus bicycle network and Burke-Gilman Trail access. A summary of planned protected bicycle lane improvements in the U District area is included in Table 4.7.

Table 4.7
PLANNED AND RECENTLY COMPLETED BICYCLE NETWORK IMPROVEMENTS – PROTECTED BICYCLE LANES, 2015–2019

Primary Street	Project Extents	Total Project Length (miles)	Planned Construction Year
Roosevelt Way NE	NE 40th Street to NE 45th Street	0.30	Complete
Roosevelt Way NE	NE 42nd Street	0.05	Complete
Roosevelt Way NE	NE 45th Street to NE 65th Street	1	Complete
NE Campus Parkway	University Way NE to Eastlake Avenue NE	0.34	Complete
University Bridge	NE Campus Parkway to Fuhrman Avenue E	0.35	Complete
Ravenna Place NE	NE 55th Street to Burke-Gilman Trail	0.17	2018

Source: Seattle Department of Transportation (SDOT).

Protected bicycle lanes have also been identified on 15th Avenue NE adjacent to campus in the Bicycle Master Plan that are not identified in the Bicycle Implementation Plan. As such, they have not been reflected in the analysis. Additional bicycle network improvements in the University of Washington vicinity include construction of a Neighborhood Greenway along NE 66th Street/NE 68th Street between 8th Avenue NE and 50th Avenue NE. Construction of this 2.2-mile project is planned for 2019. In addition, the University Bridge improvements are included as a catalyst project. A proposed future bicycle network is shown in Figure 4.3.



Source: Sasaki Architects, July 2017 CMP

Figure 4.3 Future Bicycle Network

4.3.2 Bicycle Parking/Bicycle Share Facilities

A study completed by UWTS in 2012 shows recent trends of bicycle parking utilization on campus. Based on the results of this survey, UWTS is working with University of Washington Department of Capital Planning and Development and the University of Washington Office of Planning and Budgeting to install additional indoor and outdoor bicycle storage facilities on campus. In addition, UWTS continues an improved bicycle parking inventory system implemented in 2013.

4.3.3 Performance Measures

As noted in Chapter 3, Affected Environment, the following bicycle-related performance measures have been identified to assess and compare alternatives:

- Burke-Gilman Trail Capacity
- Bicycle Parking and Utilization
- Quality of Bicycle Environment

Burke-Gilman Trail Capacity

Bicycle traffic along the Burke-Gilman Trail is anticipated to increase with the No Action Alternative from citywide growth and growth in travel to and from the Link light rail University of Washington Station as ridership of the system increases. Local pedestrian traffic along and across the Burke-Gilman Trail is also anticipated to increase but by a lesser amount. As shown in Table 4.8 bicycle and pedestrian volumes are projected to increase between 1 and 6 percent per year along the various segments. These increases would result from overall area growth and changing transportation mode choices as new transit investments are implemented, including new light rail stations (University of Washington and U District).

Table 4.8
BURKE-GILMAN TRAIL FORECASTED GROWTH 2010 TO 2030

Trail Location	2010		2028[1]		2030		Bicycle % Annual Change (2010–2030)	Pedestrian % Annual Change (2010–2030)
	Bicycle Counts	Pedestrian Counts	Bicycle Counts	Pedestrian Counts	Bicycle Counts	Pedestrian Counts		
West of University Bridge	408	174	1,230	251	1,321	260	6%	2%
West of 15th Avenue NE	479	249	1,441	341	1,548	351	6%	2%
Hitchcock Bridge	459	243	1,457	634	1,568	677	6%	5%
T-Wing Overpass	449	260	1,459	783	1,571	841	6%	6%
Rainier Vista West	474	298	1,415	357	1,520	364	6%	1%
Hec Edmundson Bridge	472	269	1,431	409	1,537	424	6%	2%
Wahkiakum Lane	425	159	1,290	277	1,386	290	6%	3%
South of Pend Oreille Road	438	136	1,330	249	1,429	261	6%	3%
North of Pend Oreille Road	435	178	1,321	299	1,419	312	6%	3%

Source: University of Washington Burke-Gilman Trail Corridor Study, SvR 2011; Transpo Group.

1. 2028 volumes estimated with straight-line interpolation from 2010 data and 2030 projections.

As pedestrian and bicycle volumes increase, the trail is expected to become more congested along segments that have not been upgraded to separate pedestrians and bicycles. According to analysis from the University of Washington Burke-Gilman Trail Corridor Study (July 2011), without separating pedestrians and people riding bicycles, LOS for both pedestrians and people riding bicycles will operate poorly (LOS F) regardless of the width of the joint use trail. The study recommends separating the trail into pedestrian- and bicycle-only facilities to accommodate an increase by the general public, new trips generated by the light rail station as well as University students, faculty and staff. A 2012 study (Burke-Gilman Trail Concept Design, Alta 2012) provided design options and recommendations for the trail. The University has completed expansion of two trail segments: a portion of the Neighborhood Reach from the University Bridge to Nordheim Court and the Campus Reach from 15th Avenue NE to Rainier Vista (completed in summer of 2016). The University is continuing to expand the trail to meet future campus and other regional growth within their 1.7-mile ownership of the trail.

Burke-Gilman Trail Concept: The University of Washington has developed conceptual plans to expand the Burke-Gilman Trail by creating separated facilities along their 1.7-mile ownership. The University of Washington Burke-Gilman Trail Design Concept Plan, Place Studio and Alta Planning + Design, 2012, created segments or reaches of the Burke-Gilman Trail and defines design concepts. Some of these segments, including portions of the Neighborhood Reach and the Campus Reach, have been completed.

As described in the Affected Environment Section, Burke-Gilman Trail level of service was evaluated with methods used in the 2011 and 2012 studies, including the use of the Federal Highway Administration's Shared-Use Path Level of Service Calculator (SUPLOS). SUPLOS evaluates trail segments using factors including trail width, directional bicycle and pedestrian volumes, and the presence of a striped centerline. (University of Washington Burke-Gilman Trail Corridor Study, July 2011). Future No Action Alternative level of service includes 2028 weekday PM peak hour pedestrian and bicycle counts in the operational analysis. The Future No Action Alternative weekday PM peak hour level of service along trail segments is summarized below. Additional detail on the operational analysis can be found in the Methods & Assumptions Appendix.

Table 4.9

NO ACTION ALTERNATIVE BURKE-GILMAN TRAIL WEEKDAY PM PEAK HOUR LEVEL OF SERVICE

Location	2028 No Action Projected Pedestrian Volume	2028 No Action Projected Bicycle Volume	Combined Trail		Separated Trail	
			Level of Service Score	Level of Service Grade	Level of Service Score	Level of Service Grade
West of University Bridge	251	1,230	NA	NA	4.16	A
West of 15th Avenue NE	341	1,441	NA	NA	4.15	A
Hitchcock Bridge	634	1,457	NA	NA	4.11	A
T-Wing Overpass	783	1,459	NA	NA	4.26	A
Rainier Vista West	357	1,415	1.45	F	3.86	B
Hec Edmundson Bridge	409	1,431	1.26	F	3.76	B
Wahkiakum Lane	277	1,290	0.82	F	3.46	C
South of Pend Oreille Road NE	249	1,330	0.82	F	3.44	C
North of Pend Oreille Road NE	299	1,321	0.68	F	3.43	C

Source: University of Washington Burke-Gilman Trail Corridor Study, SvR 2011; Transpo Group. NA means the trail is separated today.

As indicated in the July 2011 corridor study, a combined trail for both pedestrian and bicycle modes results in a much lower level of service than a separated trail. Level of service along the Burke-Gilman Trail can be improved by allowing for separation of bicycle and pedestrian modes. The segments of the Burke-Gilman trail have been developed as a separate trail form the west edge of the study area to Rainier Vista and will meet current and future demand. The segments east and of Rainier Vista operate with a poor level of service and will only improve when the trail is separated as planned.

Bicycle Parking and Utilization

As described in the Affected Environment chapter, the University has effectively managed bicycle parking demand. As new buildings are constructed, more than sufficient parking supply is provided. For these reasons, additional bicycle parking analysis for the No Action Alternative was not completed.

Quality of Bicycle Environment (Primary & Secondary Impact Zones)

Under the No Action Alternative, improvements to the bicycle environment associated with City and WSDOT investments are expected along with growth in bicycle travel demand associated with expanded Link light rail access and citywide growth. Improvements to bicycle travel, including upgrades to bicycle facilities along NE 40th Street and 11th Avenue NE, will be completed by SDOT before 2020, with additional investments possible thereafter. These investments will expand connectivity of facilities for all ages and abilities, especially in West Campus. Completion of the SR 520 HOV and Bridge Replacement Project will also improve regional bicycle travel to the Eastside, improve bicycle travel in the Montlake neighborhood, and provide new connectivity between the University, Capitol Hill, and Eastlake neighborhoods.

As mentioned in Section 4.2.2, additional Neighborhood Greenways are planned within the study area. Neighborhood Greenways accommodate both pedestrians and people riding bicycles. These Greenways will improve bicycle connectivity throughout the study area, especially between the primary and secondary impact zones.

The recently installed protected bike lane running north-south along Roosevelt Way NE highlights bicycle connectivity improvements within the primary impact zone. Protected bike lanes are also planned by the City along 11th Avenue NE, 12th Avenue NE, and along NE 40th Street, west of Brooklyn Avenue NE. This would connect with the existing cycling infrastructure on NE 40th Street and improve connectivity to campus.

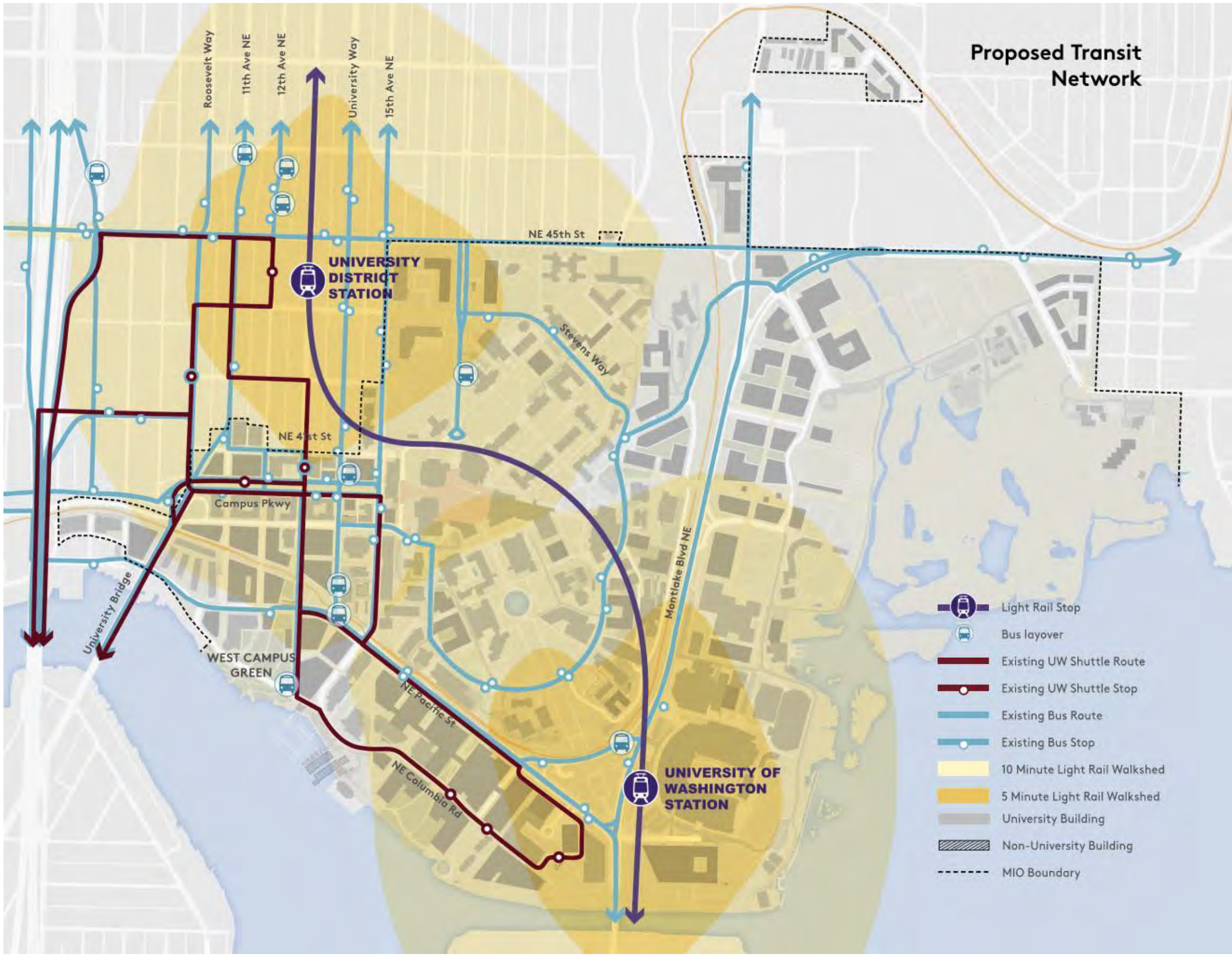
In addition to bicycle improvements within the primary impact zone, improvements are planned within the secondary impact zone. A new protected bike lane along Ravenna Place NE will provide a direct connection between the Burke-Gillman Trail and Ravenna Park. In addition, a protected bike lane along 36th Avenue NE will increase bicycle connectivity in the north/south directions to the secondary impact zone. A planned Neighborhood Greenway along Fairview Avenue E will increase the bicycle rider connection to campus from the south.

4.4 TRANSIT

4.4.1 Planned Improvements

Planned transit improvements will alter the transit system framework in the University District. The Sound Transit University Link Extension, which was completed in 2016, connects Link light rail as far north as Husky Stadium from Downtown. Current funding supports the Sound Transit Northgate Link Extension scheduled to be completed in 2021 and the Lynnwood Link Extension scheduled to be completed in 2023. The Northgate Link Extension will consist of a 4.3-mile-long light rail extension that connects the University of Washington Station with a planned Northgate Station, including stops at the U District and Roosevelt stations. Source: **Sasaki Architects, July 2017 CMP**

Figure 4.4 includes the planned transit network and walksheds from the U District Station and the existing University of Washington Station.



Source: Sasaki Architects, July 2017 CMP

Figure 4.4 Planned Transit Network and Walkshed

The Sound Transit Northgate Link light rail extension is funded and included in the Sound Transit 2 (ST2) System Plan project phasing. Other planned Sound Transit improvements are included in the Sound Transit 3 (ST3) System Plan approved in November 2016. ST3 improvements within the plan horizon include extension of light rail to downtown Redmond and extension of bus rapid transit (BRT) to Bothell. Other ST3 investments include light rail extensions and BRT and Sounder rail investments that could occur beyond the University Campus Master Plan planning horizon year of 2028.

The growth of transit use from new light rail access at the University of Washington is expected to increase access to campus by fast, reliable transit modes. As evidenced by the immediate increase of ORCA taps (Table 2.3) by University members using light rail, access to light rail should increase the transit mode for students, faculty, and staff. As shown in Figure 2.3 and Table 2.3, using current employee (staff and faculty) home ZIP code data, extension of light rail will be within convenient access for University employees. Roughly 24 percent of University employees will be within a 1-mile travelshed of new stations. Considering light rail is a convenient travel mode to the University of Washington, estimates of access to light rail for all employees in adjacent ZIP codes is as high as 59 percent.

Connections to Link light rail from Sounder Commuter Rail, whose riders can access light rail at the International District/Chinatown Station, has also become more convenient for locations in Pierce and Southeast King County. These connections have resulted in an increase of Sounder Light Rail taps by University of Washington-related ORCA cards from 10 to 25 percent over 2015 (pre-light rail). As shown in the Table 2.3, including those employees adjacent to Sounder rail stations along with light rail riders shows an increase in future access to 27 percent. These findings are also summarized in Figure 2.3.

Table 4.10
PROPORTION OF EMPLOYEES PROXIMATE TO LIGHT RAIL

Year	½-Mile Proximity to Light Rail Station		½-Mile Proximity to Light Rail Station and 1-Mile Proximity to Sounder Rail Station		ZIP Code Adjacent to Light Rail Station		ZIP Code Adjacent to Light Rail Station and 1-Mile Proximity to Sounder Rail Station	
	Employees	Percent of Employees	Employees	Percent of Employees	Employees	Percent of Employees	Employees	Percent of Employees
Existing	844	3%	1,483	6%	6,223	24%	6,862	27%
2021 (Light Rail extended to Northgate)	1,383	5%	2,022	8%	12,132	47%	12,771	50%
2023 (Light Rail extended to Lynnwood, Federal Way, and Overlake)	1,913	7%	2,552	10%	14,850	58%	15,489	61%
2024 (Light Rail extended to Redmond)	1,973	8%	2,612	10%	15,107	59%	15,746	62%

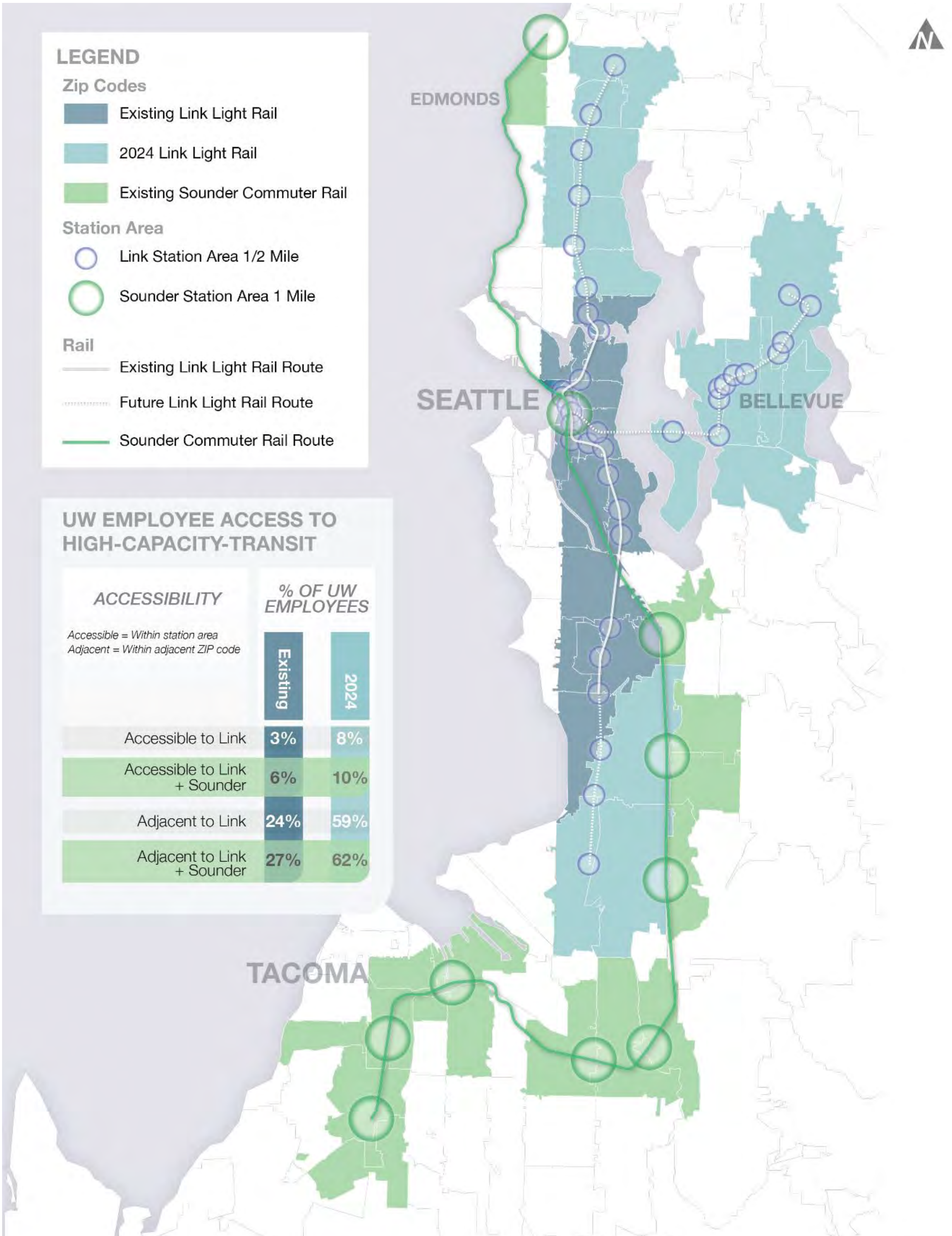


Figure 4.5 Employees Located in ZIP Codes within 1/2 Mile of Light Rail 1 Mile of Sounder Commuter Rail

The City of Seattle Transit Master Plan, which was updated in 2016, identifies a set of RapidRide Transit Priority Corridors. These corridors include enhancements to support transit, including amenities at stops such as shelters, real-time information, transit signal priority, and off-board fare payment. Three of these are funded as part of the Move Seattle levy: RapidRide corridors 4 (U District to Rainier Valley), 5 Ballard to U District), and 7 (Northgate to Downtown by way of the U District).

4.4.2 Route Modifications

The King County METRO CONNECTS plan includes proposed routes for plan horizon years 2025 and 2040. Twelve new RapidRide routes are proposed for implementation in 2025, with four servicing the University of Washington campus or the U District. Table 4.11 summarizes King County Metro's proposed RapidRide expansion routes by 2025 in the University of Washington vicinity.

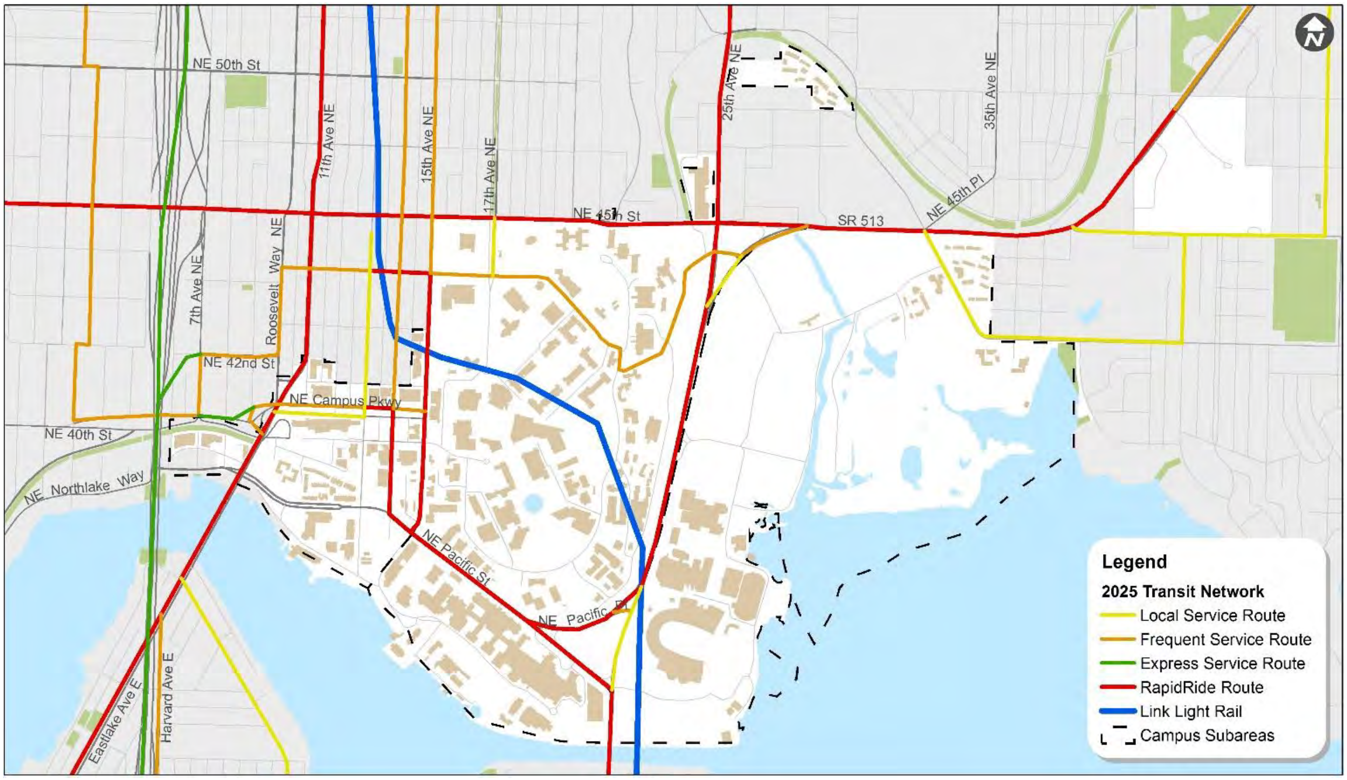
Table 4.11
KING COUNTY METRO PROPOSED RAPIDRIDE ROUTES, 2025

Primary Current Route(s)	Routing	Route Miles
372	Bothell – University of Washington – Lake City	13.3
44	Ballard – Children's Hospital – Wallingford	5.9
7s, 48s	U District – Rainier Beach – Mount Baker	10.7
7n, 70	U District – Mount Baker – Seattle Central Business District	7.7

Source: King County Metro Future RapidRide Expansion, 2016.

Based on the King County METRO CONNECTS Long-Range Plan 2016, King County Metro plans to expand frequent, express, and local services throughout Seattle to reach 6 million service hours from the existing 3.5 million hours. Frequent service includes arrivals every 5 to 15 minutes (or better) on weekdays and arrivals every 15 minutes on weekends. Frequent service also includes RapidRide routes. King County Metro plans to add bus lanes, transit signal priority, and transit queue jumps to allow for additional frequent and RapidRide service. Express service includes arrivals every 15 to 30 minutes during the day, which will serve large population areas along main travel corridors. Local service will include arrivals every 30 to 60 minutes throughout the day, with increased frequency during peak periods. Stops along local service routes are typically 0.25 to 0.5 miles apart, and service is geared towards lower-density areas with less access to transit.

Figure 4.6 illustrates the overall 2025 transit service network, including King County Metro's planned improvements.

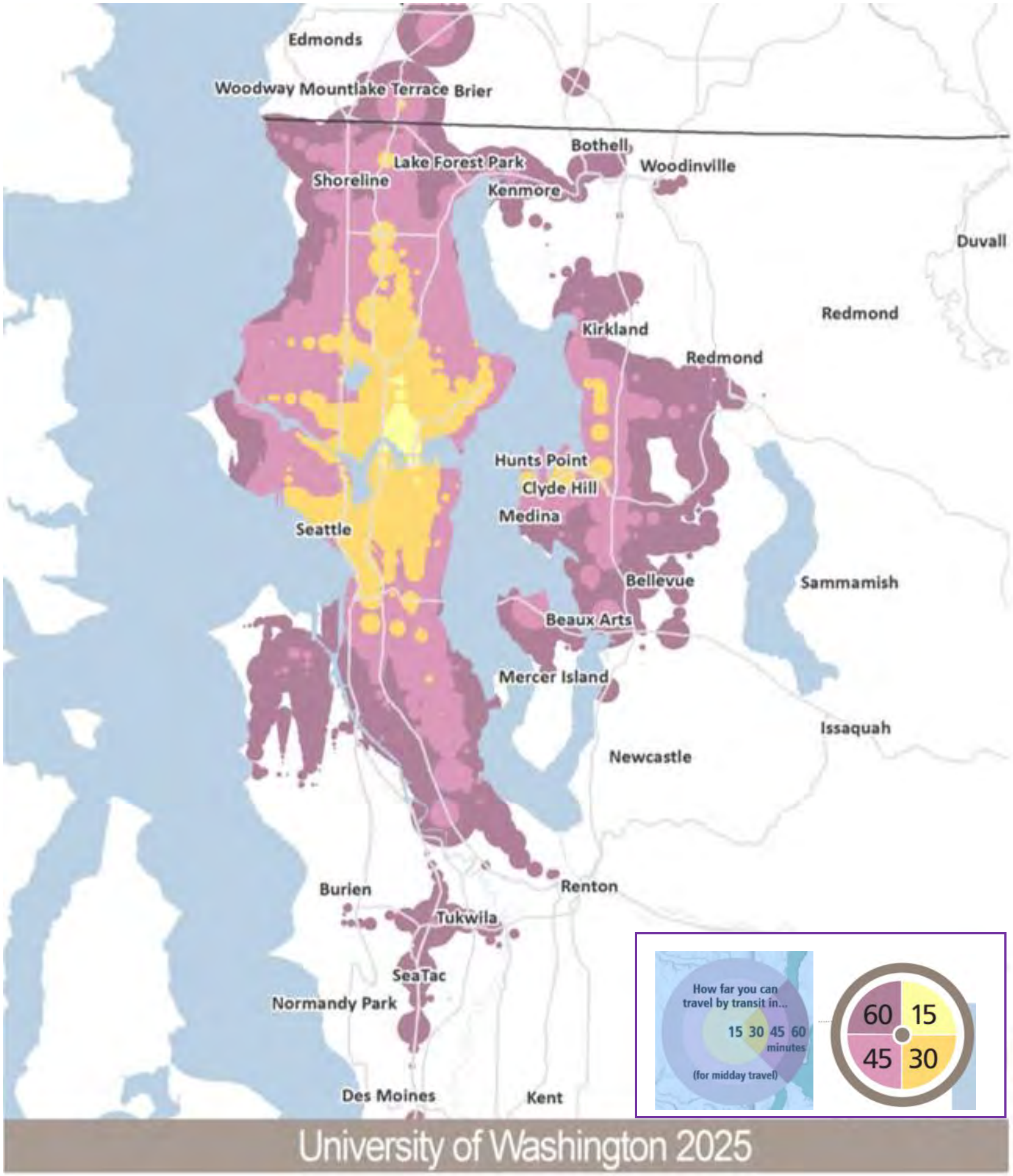


Source: King County Metro Draft Long-Range Plan Online Service Network Map, Spring 2016

Figure 4.6 King County METRO CONNECTS 2025 Service Network

As shown in Figure 4.6, King County Metro's planned 2025 service network will include frequent, express, and local routes with access to the University of Washington campus and U District.

Figure 4.7 shows transit travel times from the University of Washington based on King County Metro's planned 2025 service network METRO CONNECTS. Colors indicate travel times within 15, 30, 45, and 60 minutes, as shown in the legend.



Source: METRO CONNECTS, 2016

Figure 4.7 Future (2025) Transit Travel Times from the University of Washington

As shown in Figure 4.7, the planned 2025 Metro service network will extend transit service to within 30 minutes of Bellevue, parts of Kirkland, Shoreline, and Lake Forest Park. Transit service within 60 minutes will expand eastward to include more of Mercer Island, Kirkland, and Redmond. Extending north, Woodinville, Mountlake Terrace, and Lynnwood will be accessible within 60 minutes. South of Seattle, transit service within 60 minutes will extend to Burien, Renton, Tukwila, SeaTac, and Des Moines.

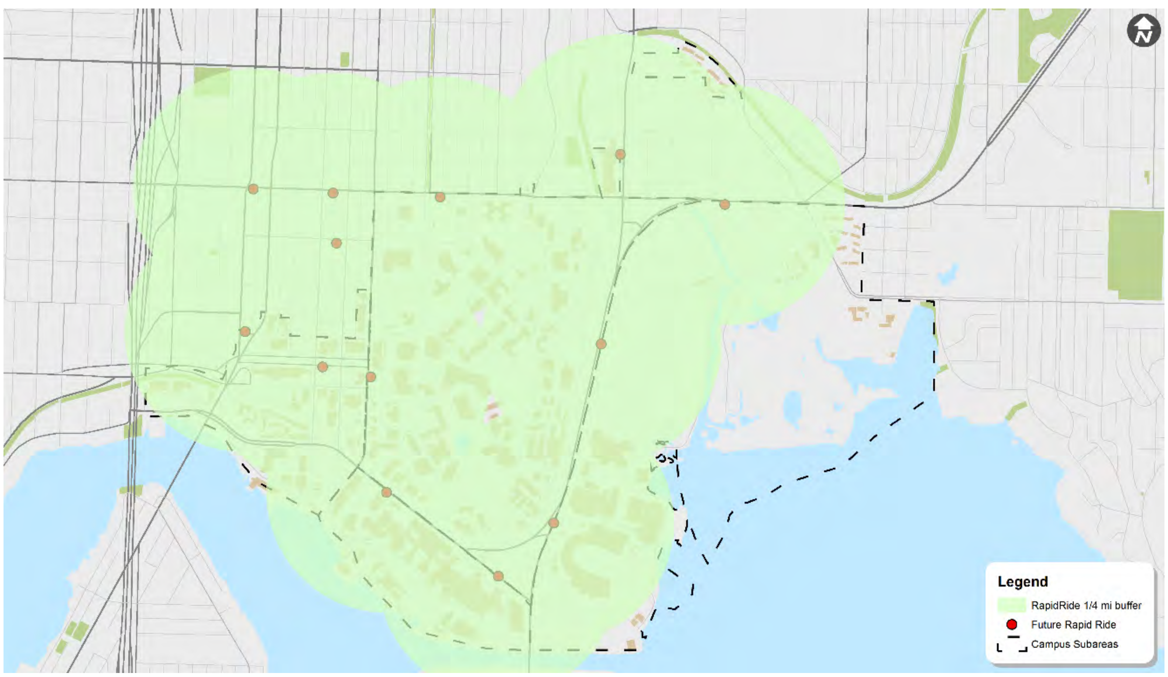
4.4.3 Performance Measures

As noted in Chapter 3, Affected Environment, the following transit-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development within 1/4 mile of RapidRide
- Proportion of Development within 1/2 mile of Light Rail
- Transit Stop Capacity
- Transit Travel Times and Delay
- Transit Loads at Screenlines

Proportion of Development within 1/4 Mile of RapidRide

This measure calculates the proportion of development that will occur within 1/4 mile of RapidRide service to the University of Washington. The details of forecasted RapidRide service are outlined in King County Metro's METRO CONNECTS Long-Range Plan 2016. The envisioned number of RapidRide stops and 1/4 buffer distances are shown below in Figure 4.8.



Source: Transpo Group, 2016.

Figure 4.8 Future RapidRide Stop Locations and 1/4-mile buffer

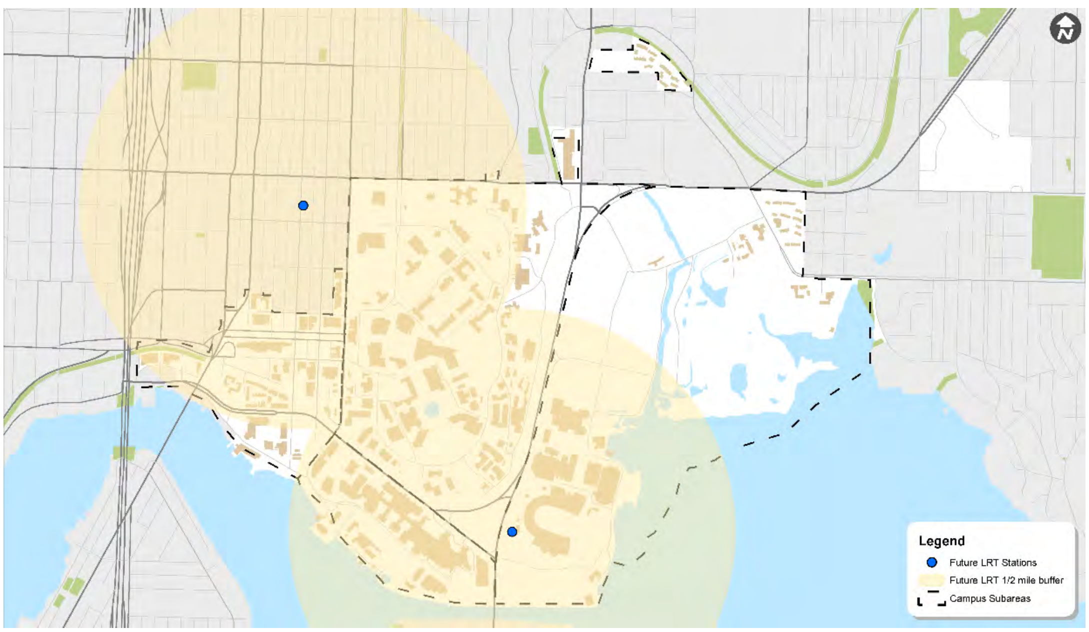
As shown in Figure 4.8, almost the entire campus is within the 1/4-mile walkshed of future RapidRide stops. All of the growth associated with the No Action Alternative would be located within the 1/4 mile walkshed of future RapidRide stops, as indicated in Table 4.12.

Table 4.12
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RAPIDRIDE

Sector	No Action Alternative
West	211,000 gross square footage (gsf)
South	NA
Central	NA
East	NA
Total	**211,00 gsf**
Percent	***100%***

Proportion of Development within 1/2 Mile of Light Rail

This measure evaluates the proportion of development within a 1/2 mile walkshed of Link light rail stations. This evaluation includes the U District Station at Brooklyn Avenue NE between NE 45th and NE 43rd streets, assumed to be completed in 2021. The future 1/2 mile walkshed to both of the University of Washington area Link light rail stations is shown in Figure 4.9.



Source: Transpo Group, 2016.

Figure 4.9 Proportion of Development within 1/2 Mile of Future Light Rail

The proportion of development with the No Action Alternative that would fall within the 1/2 mile walkshed of Link light rail stations is shown in Table 4.13.

Table 4.13
DEVELOPMENT WITHIN 1/2 MILE OF LIGHT RAIL

Sector	No Action Alternative
West	181,460 gross square footage (gsf)
South	NA
Central	NA
East	NA
Total	**181,460 gsf**
Percent	***86%***

Transit Stop Capacity
Transit Stop Capacity evaluates the number of buses that a bus stop can process in an hour. This analysis was done for four pairs of stops on key transit corridors around the University of Washington: 15th Avenue NE, NE 45th Street, Montlake Boulevard NE, and NE Pacific Street. The following section summarizes the bus stop capacity and the bus demand at each of these stops with the No Action alternative.

Existing and Future Transit Stop Capacity and Demand

Transit Stop Capacity was estimated using the Transit Cooperative Research Program (TCRP) Report 165 – Transit Capacity and Quality of Service Manual. This methodology provides a spreadsheet that uses inputs like stop dwell times, stop location, stop type, proximity to intersection, conflicting right-turn volumes, and others to estimate the number of buses that each stop can process. The number of buses forecast to be traveling through each stop was taken from the METRO CONNECTS Long-Range Plan 2016. It was assumed that all buses traveling along the corridors would stop at each of the stops being analyzed. The results of this analysis are provided in Table 4.14.

Table 4.14
TRANSIT STOP CAPACITY – EXISTING AND NO ACTION DEMAND

Stop	Capacity (buses/hour)	Existing Demand (buses/hour)	No Action Alternative Forecast Demand (buses/hour)
15th Ave NE at NE 42nd St (northbound)	68	30	35
15th Ave NE at NE 43rd St (southbound)	69	30	35
NE 45th St & University Way (eastbound)	56	18	8
NE 45th St & Brooklyn Ave NE (westbound)	39	18	8
NE Pacific St & 15th Ave NE (southeast bound)	70	35	33
NE Pacific St & 15th Ave NE (northwest bound)	82	35	33
Montlake Blvd NE & Pacific Pl (northbound)	28	18	19
Montlake Blvd NE & Pacific Pl (southbound)	67	18	19

The No Action Alternative forecast demand decreases from existing demand at stops along NE 45th Street and NE Pacific Street, while the No Action Alternative forecast demand increases at stops along 15th Avenue NE and Montlake Boulevard NE.

Transit Travel Times and Delay

The Transit Travel Speed analysis evaluates the PM peak hour transit travel speeds on key corridors around and on the University of Washington campus for the year 2028. This assumes background development and implementation of the U District Rezone. These corridors are listed below and are shown on Figure 4.10:

- NE 45th Street
- NE Pacific Street
- 11th Avenue NE
- Roosevelt Way NE
- 15th Avenue NE
- Montlake Boulevard NE
- Stevens Way NE

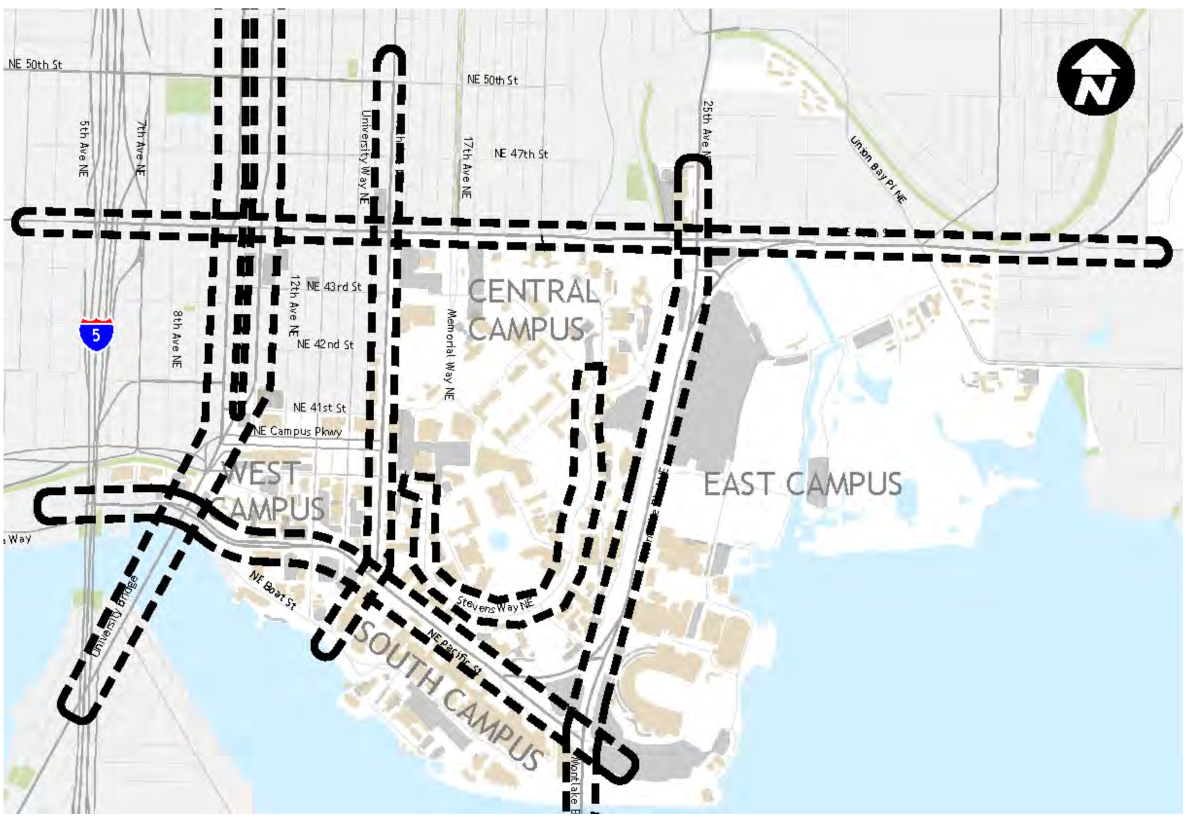


Figure 4.10 Transit Study Corridors

Background Transit Service Changes

Between the existing (2016) and 2028 horizon year, the transit service network surrounding the University of Washington will be completely transformed. The new Link light rail U District Station will be opening on Brooklyn Avenue NE between NE 43rd and NE 45th streets (open 2021), and multiple RapidRide corridors will be serving the University of Washington. King County Metro's recently adopted METRO CONNECTS long-range plan was used as the baseline condition for all future (2028) horizon year transit operations. A current planning process by the City of Seattle—One Center City—is considering transit service changes for 2018. This would involve in the near-term reallocating SR 520 transit service from the Eastside and destined to Downtown to truncate to the University of Washington Station. In the longer term, it is likely that the METRO CONNECTS service plan would be in place as opposed to the One Center City 2018 service concept.

Community Transit currently provides direct connections between Snohomish County communities and the University of Washington. When light rail extends north to Lynnwood in 2023, their intention is to no longer serve communities along I-5 in King County, specifically Downtown Seattle and the U District. In projecting volumes, no reassignment of Community Transit route volumes was conducted for this analysis. For example, Route 41 to Northgate may be eliminated when it becomes redundant with light rail.

Forecasting Transit Speeds Methodology

To forecast transit speeds, the change in travel speeds between existing and 2028 horizon vehicle speeds (from Synchro traffic models) was added to the existing transit speeds, and new dwell times were calculated based on projected transit passenger volumes. The existing average number of passenger boardings and alightings at each stop was calculated from the existing automatic passenger count data provided by King County Metro and Community Transit, and then a growth rate of 12 percent was applied to forecast to 2028 conditions. Given the number of passengers boarding and alighting at each station, a dwell time of 2.75 seconds per boarding and 2.5 seconds per alighting was used to compute the forecast dwell conditions. Detailed methodology can be found in the Methodology and Assumptions Appendix.

To summarize, the 2028 Transit Speed = Existing Transit Speed + (No Action Vehicle Speeds – Existing Vehicle Speeds) + (Forecast Dwell Time – Existing Dwell Time).

Table 4.15 summarizes the No Action Alternative transit travel speeds and compares them to existing transit speeds.

Table 4.15
EXISTING AND NO ACTION ALTERNATIVE TRANSIT TRAVEL SPEEDS

Corridor	Existing Transit Speed (mph)	No Action Transit Speed (mph)
NE 45th Street Eastbound	5.2	4.8
NE 45th Street Westbound	5.2	4.0
NE Pacific Street Eastbound	14.7	12.3
NE Pacific Street Westbound	7.3	18.3
11th Avenue NE Northbound	5.9	5.1
Roosevelt Way NE Southbound	12.6	4.9
15th Avenue NE Northbound	7.8	14.1
15th Avenue NE Southbound	5.8	6.8
Montlake Boulevard NE Northbound	20.0	15.1
Stevens Way NE Eastbound	6.8	8.8
Stevens Way NE Westbound	2.7	3.0

Note: mph = miles per hour

As expected, most corridors would see a decline in transit travel speeds. Notably, Roosevelt Way NE northbound speeds would decline by more than half. Two corridors are anticipated to see an improvement from existing to No Action conditions: NE Pacific Street westbound and 15th Avenue NE northbound. According to METRO CONNECTS, both of these corridors are future RapidRide corridors that will serve between 40 and 65 buses an hour, thus resulting in a very low average number of boardings and alightings per bus. As a result, dwell times are forecasted to decrease significantly and overall transit speed is forecasted to increase on these corridors under the No Action Alternative.

Transit Loads at Screenlines

Forecast Data

Forecast (2028) transit screenline values are based on data collected at the same locations as identified in the existing conditions analysis presented in Chapter 3, Affected Environment. The forecast capacity analysis used the same methodology as in the existing conditions analysis; however, the routes assumed are based on the 2025 planned routes identified in the recently adopted METRO CONNECTS. Two forecast demand scenarios were analyzed: (1) 2028 horizon year with background growth and (2) 2028 with background growth and an increase in University of Washington pedestrian trips generated by new campus development proposed in the 2018 CMP.

- **2028 Capacity** – Transit screenline demand was calculated using the same methodology as for the existing conditions analysis in Chapter 3, Affected Environment. To determine future routes passing through transit screenlines, King County Metro's Service Network Map, a component of METRO CONNECTS, was used. King County Metro provides planned 2025 route information, including service type (frequent, express, local, and RapidRide). The service type was used to estimate the type of bus that would serve the route, and the assumed bus service was used in the analysis. Values assumed in the capacity analysis are found in the following table.

- **2028 Demand** – Baseline demand was developed to represent background growth. A 12 percent growth rate was applied to the load at existing transit screenlines to arrive at 2028 background demand. At both the Link light rail University of Washington and U District stations, through-trips were added to the baseline boardings develop total screenline demand. Sound Transit's estimate of 60,000 daily riders on the Lynnwood Link Extension was used to determine these through-trips.

Table 4.16
NO ACTION ALTERNATIVE TRANSIT ROUTES, FREQUENCY, AND CAPACITY

Route[1]	Peak Headway[2]	Peak Trips[3]	Route Type[4]	Seated Capacity[5]
31	20	2	Local	40
32	20	2	Local	40
540	20	2	ST	40
542	15	3	ST	65
554	30	1	Express	65
556	30	1	ST	65
1002	10	5	Frequent	65
1009	10	5	Rapid	65
1012	10	5	Rapid	65
1013	10	5	Frequent	65
1014	10	5	Frequent	65
1019	10	5	Frequent	65
1063	10	5	Rapid	65
1064	10	5	Frequent	65
1071	10	5	Rapid	65
1996	10	5	Frequent	65
2004	10	5	Frequent	65
2516	15	3	Express	65
2998	15	3	Express	65
3008	30	1	Local	40
3101	30	1	Local	40
3122	30	1	Local	40
3123	30	1	Local	40
3208	30	1	Local	40
Link	3	39	Rail	600[6]

1. Identified using METRO CONNECTS Service Network Map for 2025
2. From King County Metro's METRO CONNECTS Long-Range Plan 2016
3. Calculated based on 60-minute peak hour with a reduction of one vehicle to account for scheduling shifts
4. Identified using METRO CONNECTS Service Network Map for 2025
5. Estimated using values found in Transit Capacity and Quality of Service Manual, 3rd Edition (TRB)
6. 150 passengers, 4 cars

Transit Screenline Analysis

To determine the effectiveness of the future transit network to service 2028 demand in the study area, transit screenline demand-to-capacity (D/C) rates were calculated by aggregating total screenline demand and aggregating total planned transit capacity. With the No Action Alternative, two locations could potentially experience capacity issues: 11th Avenue NE south of NE 45th Street and University Way south of NE 43rd Street. These screenlines would operate at a utilization of over 100 percent, which indicates that there would be insufficient transit capacity at these locations. Total bus D/C would be 46 percent and total Link D/C would be 61 percent, with 56 percent overall D/C across all modes and screenlines. Transit users at the screenlines, which are over capacity during the PM peak hour, could shift to other screenlines as a screenline approaches capacity. Screenline D/C for the No Action Alternative is shown in Table 4.17.

Table 4.17
NO ACTION ALTERNATIVE TRANSIT SCREENLINE DEMAND-TO-CAPACITY

Screenline Number	Location	Capacity		Demand		No Action D/C (Demand to Capacity)
		Passengers	Change from Existing	Passengers	Change from Existing	
1	NE 45th St west of Mary Gates Drive	2,430	1,250	655	71	27%
2	NE 45th & Roosevelt Way NE	1,040	-690	610	66	59%
3	Roosevelt Way NE south of NE 45th St	325	-195	121	13	37%
4	11th Ave NE south of NE 45th St	325	-195	216	-170	67%
5	15th Ave NE south of NE 43rd St	4,200	600	1,084	117	26%
6	University Way NE south of NE 43rd St	650	-390	459	-361	71%
7	Campus Pkwy east of Brooklyn Ave NE	1,210	-600	995	-115	82%
8	NE Pacific St east of 15th Ave NE	4,140	-520	969	104	23%
9	Stevens Way at Pend Oreille	1,860	-210	1,175	126	63%
10	Montlake Bridge	2,270	80	1,095	118	48%
11	University Bridge	1,380	460	724	78	52%
12	Montlake Blvd NE	730	-50	333	36	46%
Bus Total		**19,830**	**-410**	**8,103**	**-250**	**41%**
Link A	U District Station	23,400	23,400	16,275	16,275	70%
Link B	University of Washington Station	23,400	14,850	16,275	14,875	70%
Link Total		**46,800**	**38,250**	**32,550**	**31,150**	**70%**
Grand Total		**66,630**	**37,840**	**40,654**	**30,901**	**61%**

4.5 VEHICLES

4.5.1 Performance Measures

Six measures of effectiveness were analyzed to evaluate the impact of the campus growth on the surrounding transportation network:

- Intersection operational level of service for intersection located in the primary and secondary impact area
- Arterial Corridor Operations
- Screenline Volumes
- Cordon Volumes
- Caps are set as 1990 trip levels to the University District and University (MIO)
- Freight Corridor Impact

4.5.2 Traffic Volumes

Primary & Secondary Impact Zone

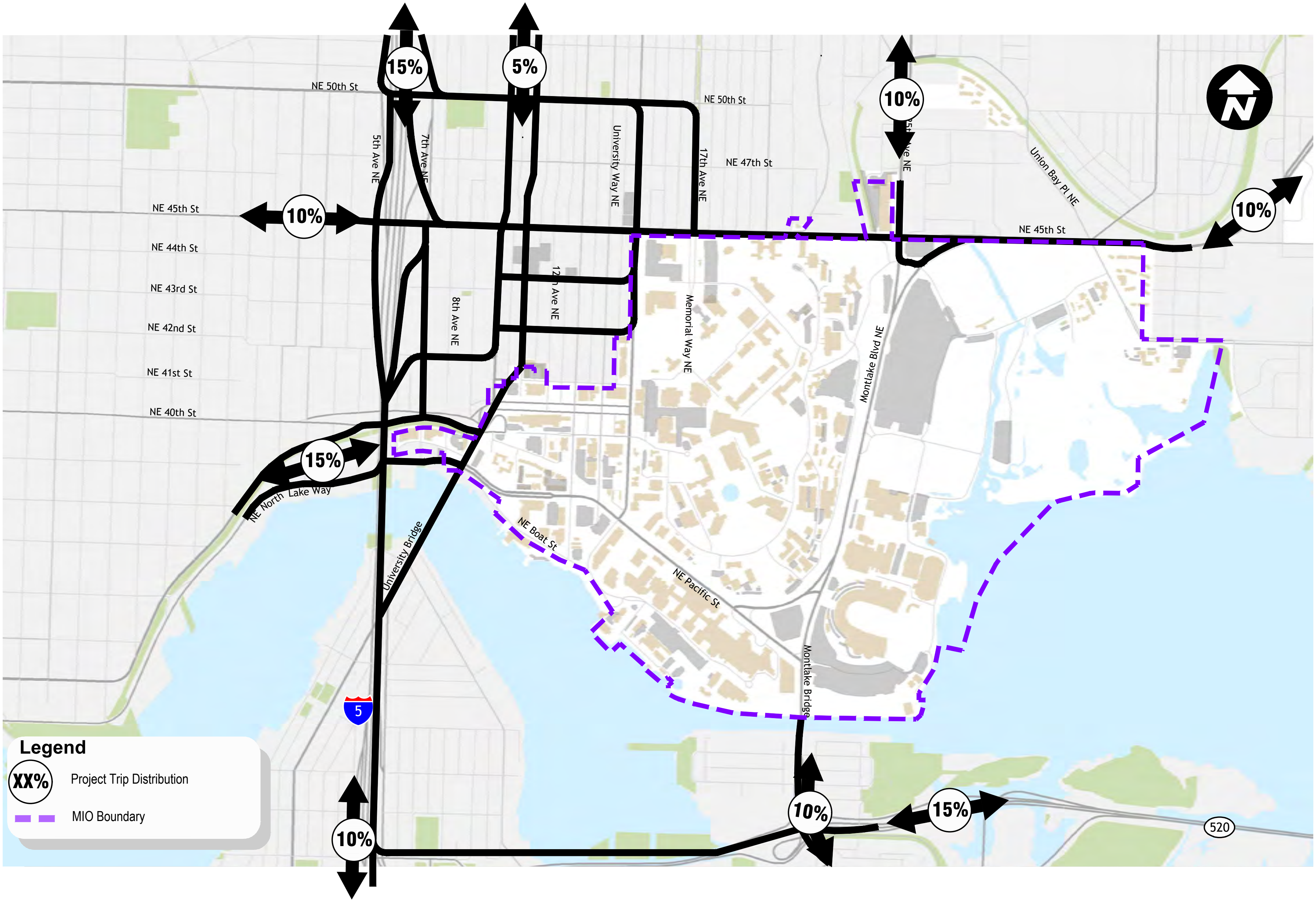
Traffic volumes for the No Action Alternative were forecast based on the approved U District Urban Design Environmental Impact Statement (EIS) and U District Rezone, which forecasts volumes to 2035. To establish 2028 horizon year volumes, a straight-line interpolation between existing 2015 counts and 2035 volumes was completed.

Trip Distribution and Assignment

Trip distribution patterns to and from the existing campus garages were based on existing vehicle travel patterns, previous studies in the project vicinity, and U.S. Census Bureau's *OnTheMap* tool. *OnTheMap* is a web-based mapping and reporting application that shows where workers are employed and where they live based on census data. Surrounding ZIP codes were evaluated to determine if a person would be more likely to travel from the ZIP code via vehicle or by other means. Individuals making trips to ZIP codes closer to the proposed project sites or in more transit-oriented locations are more likely to use transit, walk, bicycle, or other drive alone modes. Individuals coming from ZIP codes outside the Seattle City limits and/or farther from the University of Washington are more likely to drive. The general trip distribution to/from the University is shown on Figure 4.11.

No Action Alternative project trips were assigned to existing West Campus garages following the above-described trip distribution. The resulting 2028 No Action volumes are shown on Figure 4.12 and Figure 4.13.

For purposes of the secondary impact zone analysis it was assumed that 5 percent of project trips would dissipate into neighborhoods or take alternate routes before reaching the secondary impact zone study intersections. The resulting future (2028) No Action Alternative volumes are shown in Figure 4.14.



The distribution considers the primary travel routes in the gridded study area where potential impacts would be the greatest. It is recognized that other routes within the gridded network may be used; however, project impacts are anticipated to be relatively minimal compared to those analyzed.

Vehicle Trip Distribution

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FIGURE **4.11**

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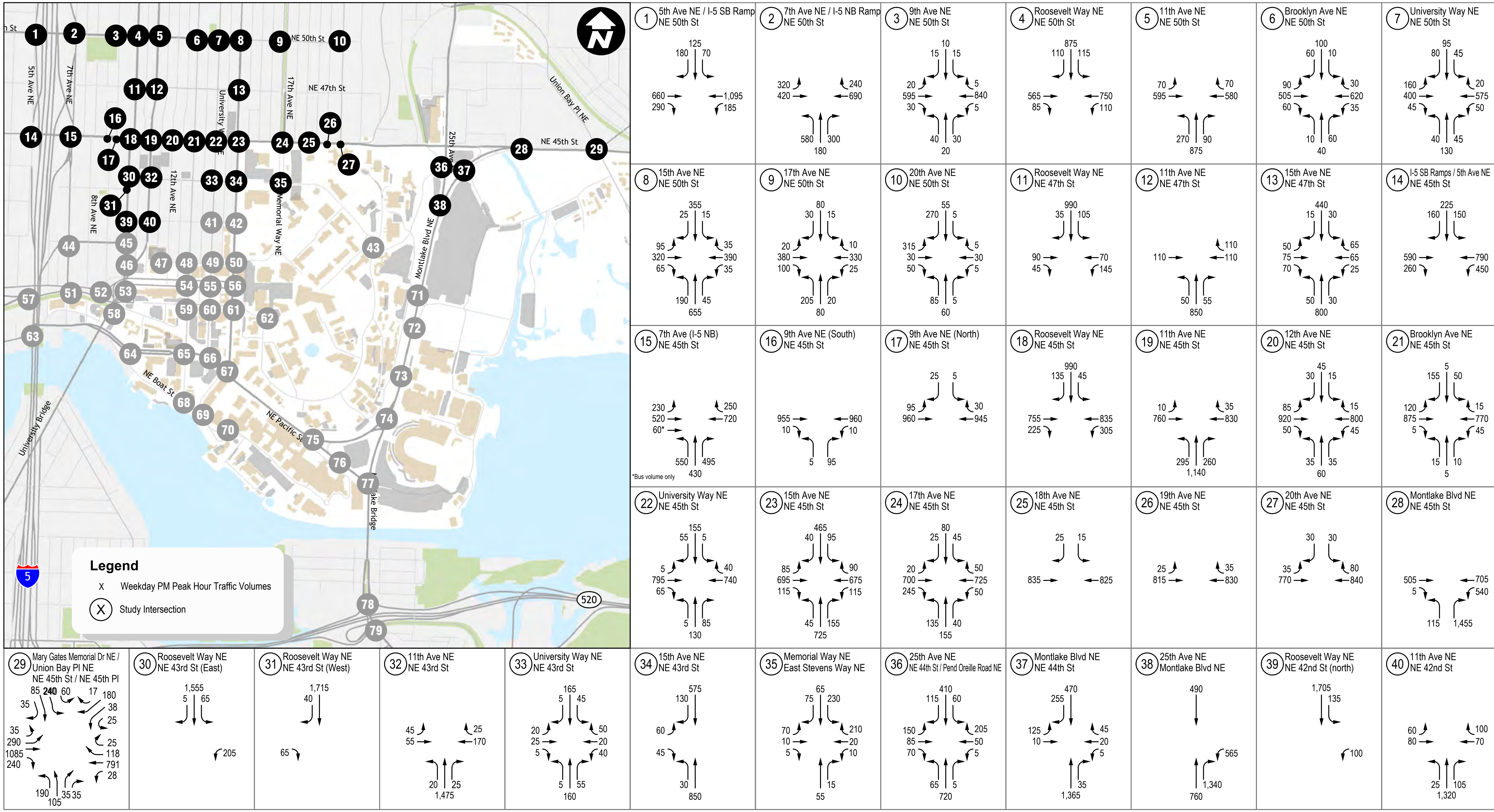

Future (2028) No Action (Intersections 1-40) Weekday PM Peak Hour Traffic Volumes

FIGURE **4.12**

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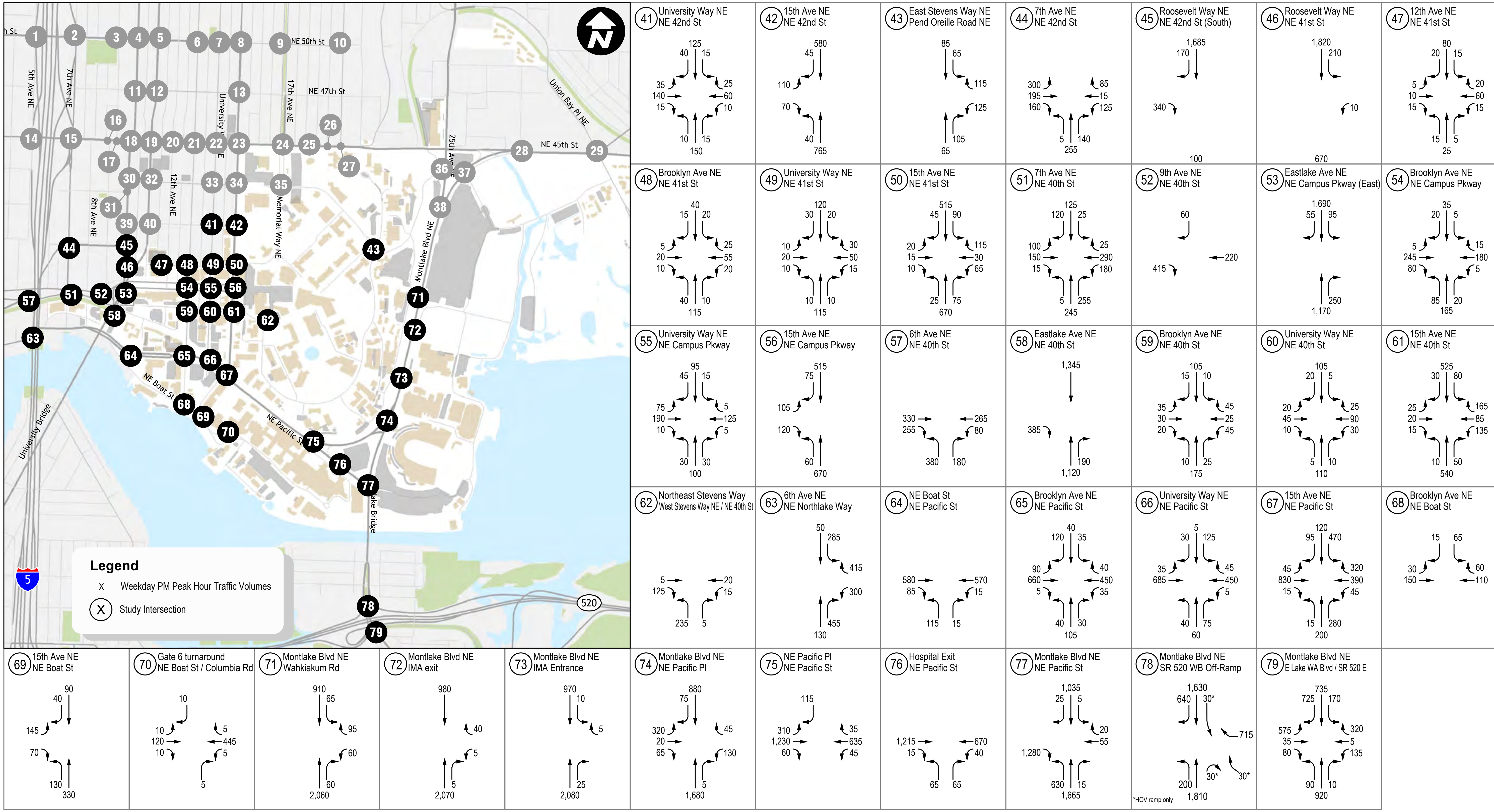

Future (2028) No Action (Intersections 41-79) Weekday PM Peak Hour Traffic Volumes

University of Washington 2018 Campus Master Plan

FIGURE **4.13**

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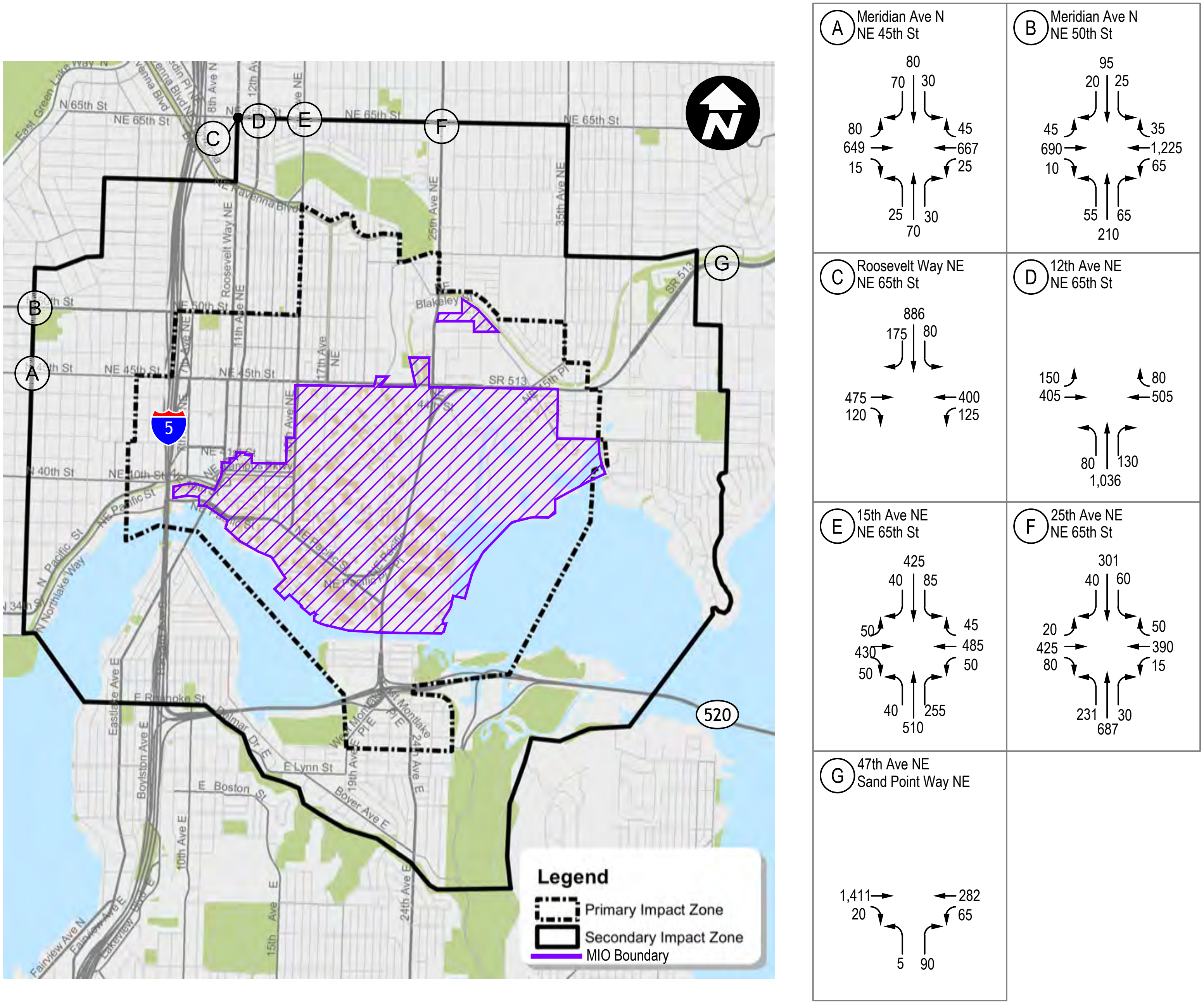

Future (2028) No Action Alternative Secondary Impact Zone Weekday PM Peak Hour Traffic Volumes

FIGURE 4.14

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4.5.3 Traffic Operations Performance

Methodology

The traffic operations evaluation within the study area included an analysis of intersection LOS and arterial travel speeds and associated LOS. The methodologies used are consistent with those described in Chapter 3, Affected Environment. A detailed description of methodology can be found in Appendix B.

Planned/funded improvements within the study area have been reflected in the analysis. The list of these projects are included in Appendix C.

Intersection Operations – Primary Impact Zone

Weekday PM peak hour intersection traffic operations under the 2028 No Action Alternative conditions are shown in Figure 4.15 and Figure 4.16. The 2028 geometry for all of the study area intersections were assumed to remain the same as existing conditions, with the exception of the Montlake Boulevard E/SR 520 westbound off-ramp intersection. Signal timing splits were optimized under 2028 No Action Alternative conditions. Complete intersection LOS summaries are provided in Appendix C.

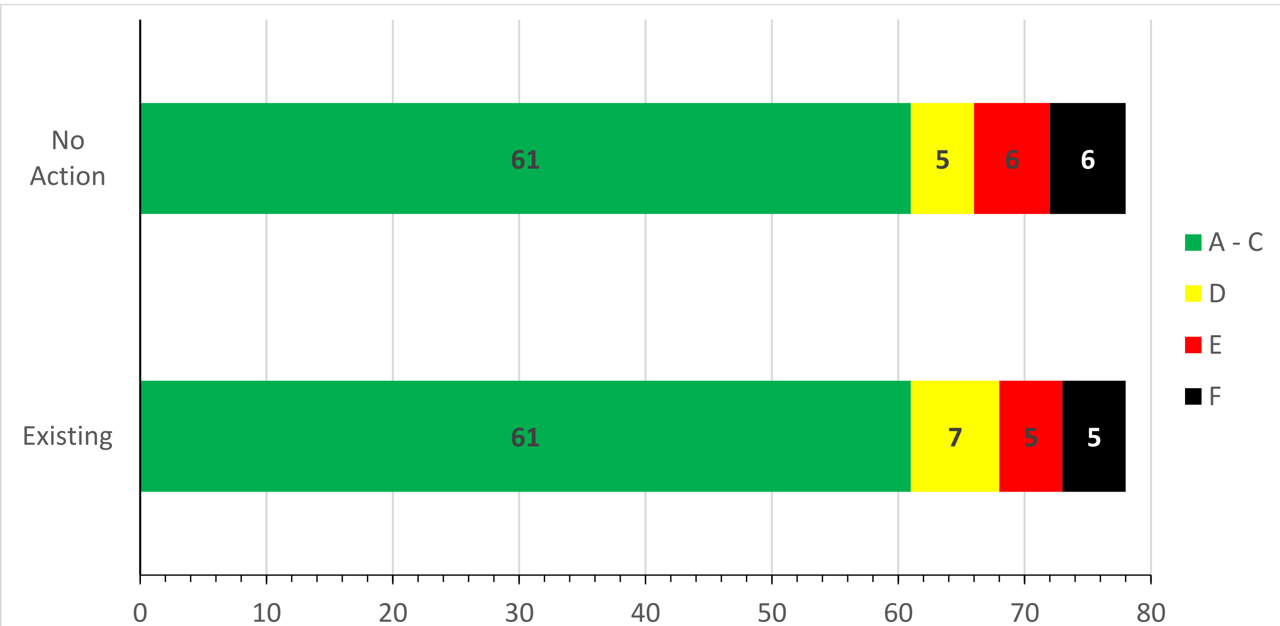


Figure 4.15 Weekday 2028 PM Peak Hour Intersection Level of Service Summary

Table 4.18 presents the intersections that are anticipated to be impacted under the No Action Alternative as compared to existing conditions.

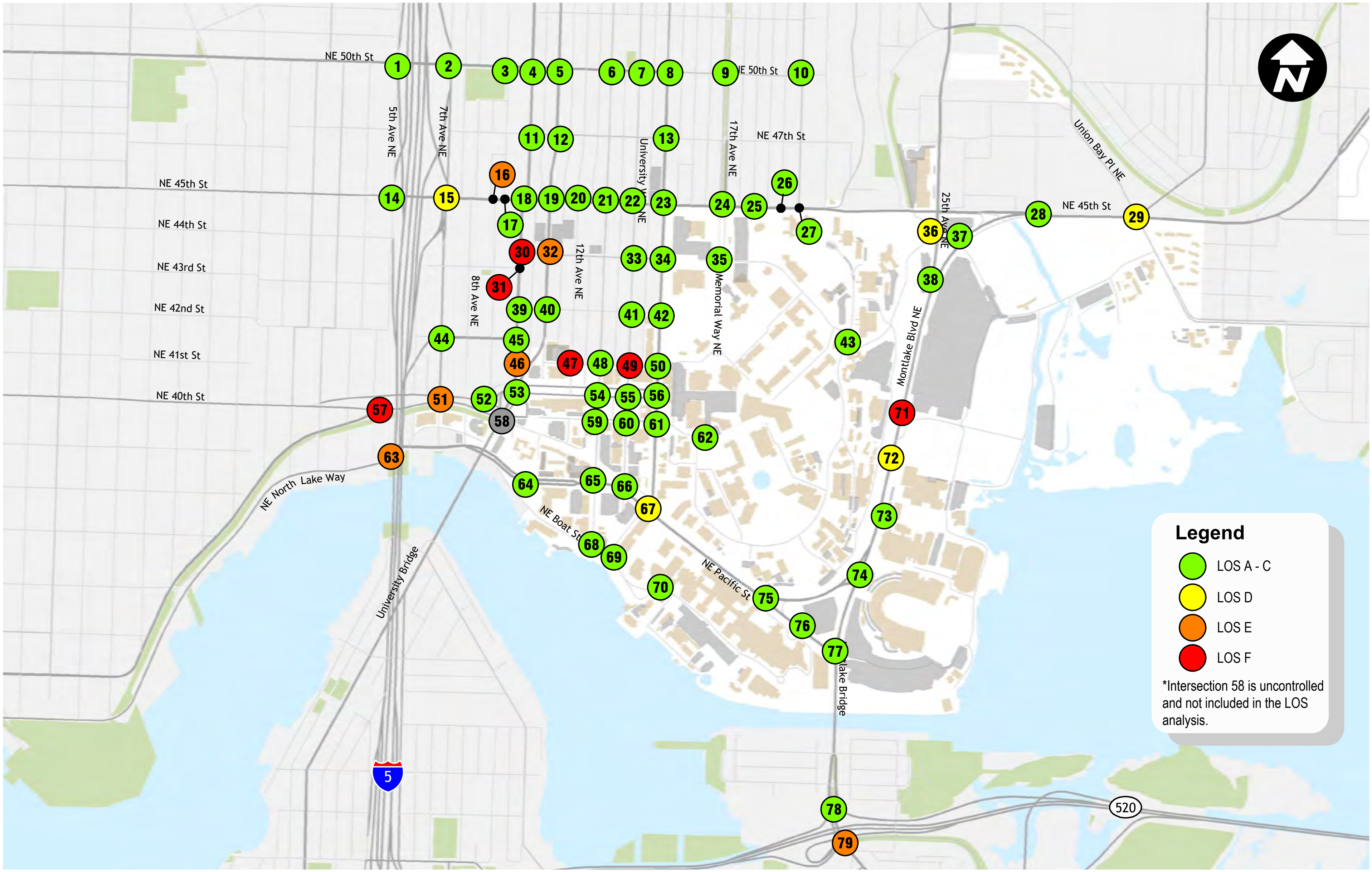
Table 4.18
INTERSECTION LEVEL OF SERVICE IMPACT SUMMARY – PRIMARY IMPACT ZONE

Intersection	Existing		No Action		Change in Delay (sec)
	LOS[1]	Delay[2]	LOS[1]	Delay[2]	
30. Roosevelt Way NE / NE 43rd St (East)	D	28	F	793	765
31. Roosevelt Way NE / NE 43rd St (West)	E	36	F	74	38
32. 11th Ave NE / NE 43rd St	B	14	E	72	58
47. 12th Ave NE / NE 41st St	E	41	F	52	11
49. University Way NE / NE 41st St	F	*	F	*	*
51. 7th Ave NE / NE 40th St	E	37	E	44	7
57. 6th Ave NE / NE 40th St	F	60	F	107	47
63. 6th Ave NE / NE Northlake Way	C	25	E	38	13
71. Montlake Blvd NE / Wahkiakum Rd	F	295	F	343	48

Note: Intersection numbers refer to figure 4.12 and 4.13
*Volume exceeds capacity and Synchro could not calculate the delay.
1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

Typically, the City does not consider an impact at intersections operating at LOS E or F, or if an intersection degrades beyond LOS D, significant if it is a less than 5 second increase in delay. The intersections listed in Table 4.18 are either anticipated to degrade from LOS D or better under existing conditions to LOS E or F, or if currently operating at LOS E or F are anticipated to experience more than a 5 second increase in delay. During the weekday PM peak hour, three additional intersection are anticipated to operate at LOS F under No Action Alternative conditions compared to existing conditions. Overall, 17 intersections are anticipated to operate at LOS D or worse during the weekday PM peak hour during No Action Alternative conditions compared with existing conditions.

With the reconfiguration of the Montlake Boulevard NE/SR 520 westbound ramps and implementation of a traffic signal, the Montlake Boulevard E/SR 520 westbound off-ramp intersection is anticipated to improve from LOS F to LOS C under baseline conditions. Additionally, modifications to the Montlake Boulevard NE/SR 520 eastbound ramps were included, and as a result the intersection is anticipated to improve from existing LOS F to LOS E under the No Action Alternative.



Future (2028) No Action Weekday PM Peak Hour Traffic Operations

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FIGURE **4.16**

Intersection Operations – Secondary Impact Zone

The weekday PM peak hour intersection traffic operations under the 2028 No Action Alternative conditions for the secondary impact zone are shown in Table 4.19. The 2028 geometry for all of the study area intersections were assumed to remain the same as existing conditions. Signal timing splits were optimized under 2028 No Action Alternative conditions. Complete intersection LOS summaries are provided in Appendix C.

Table 4.19
INTERSECTION LEVEL OF SERVICE SUMMARY – SECONDARY IMPACT ZONE

Intersection	Existing		No Action		Change in Delay (sec)
	LOS[1]	Delay[2]	LOS[1]	Delay[2]	
A. Meridian Avenue N/N 45th Street	B	11	B	12	1
B. Meridian Avenue N/N 50th Street	B	13	B	17	4
C. Roosevelt Way NE/NE 65th Street	D	41	E	73	32
D. 12th Avenue NE/NE 65th Street	C	23	C	23	0
E. 15th Avenue NE/NE 65th Street	F	133	F	161	28
F. 25th Avenue NE/NE 65th Street	E	78	E	80	2
G. 47th Avenue NE/Sand Point Way NE	C	19	D	30	11

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

As shown in Table 4.19 the secondary impact zone intersections are anticipated to operate at the same LOS under the No Action Alternative as they do under existing conditions with the exception of one intersection. The Roosevelt Way NE/NE 65th Street intersection is anticipated to degrade from LOS D to LOS E with approximately a 32 second increase in delay.

4.5.4 Arterial Operations

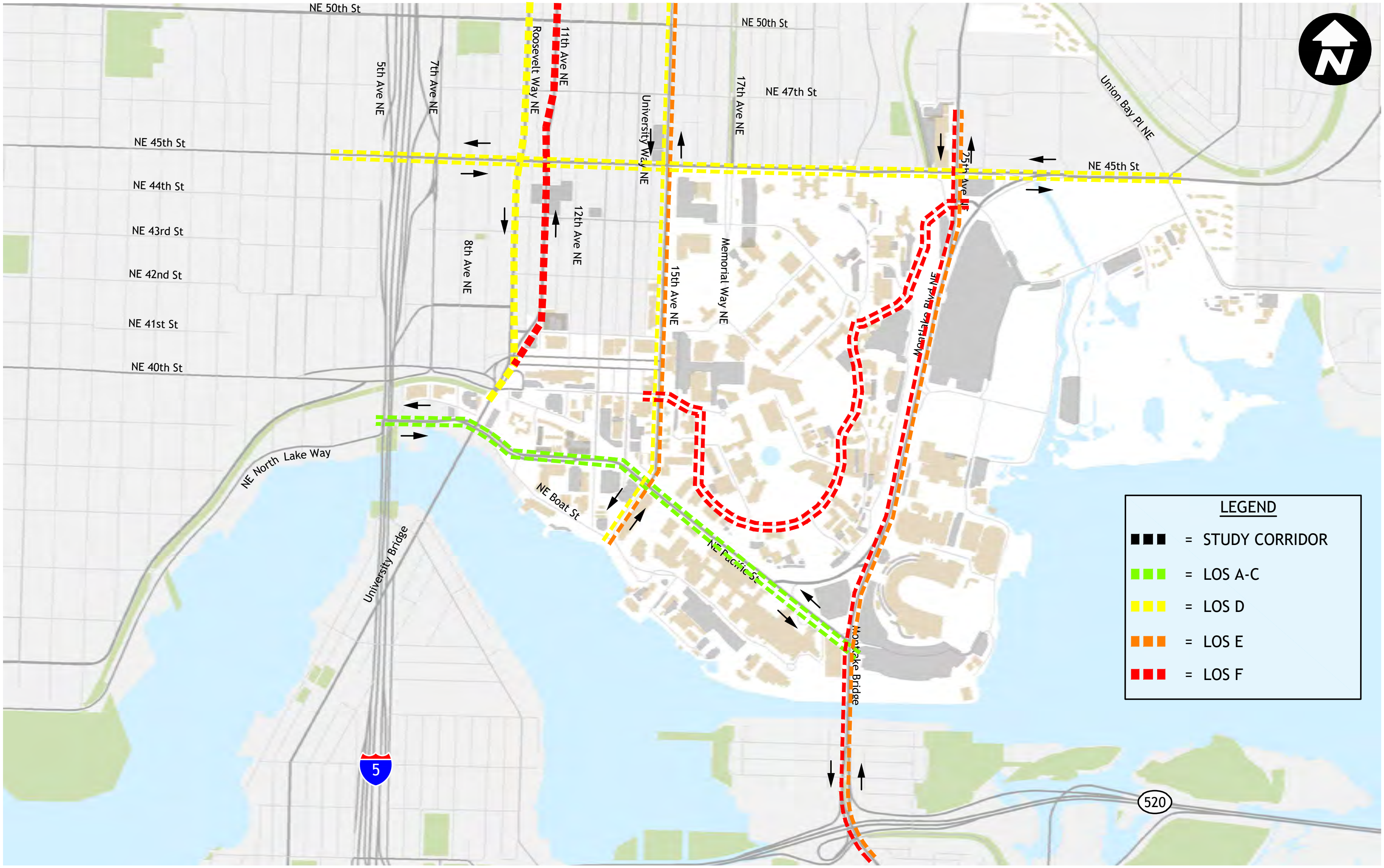
Arterial travel times and speeds shown in Table 4.20 along NE 45th Street, NE Pacific Street, 11th Avenue NE, Roosevelt Way NE, 15th Avenue NE, Montlake Boulevard NE, and Stevens Way NE were evaluated using the Synchro 9 network that was used for the intersection operations analysis. The No Action Alternative results reflect the adjustment factors described in Chapter 3, Affected Environment.

Table 4.20
WEEKDAY PM PEAK HOUR ARTERIAL LOS SUMMARY

Corridor	Existing		No Action	
	LOS[1]	Speed[2]	LOS[1]	Speed[2]
11th Avenue NE between NE Campus Parkway and NE 50th Street				
Northbound	E	8.5	F	5.0
15th Avenue NE between NE Boat Street and NE 50th Street				
Northbound	E	8.2	E	8.0
Southbound	D	9.4	D	9.2
Montlake Boulevard NE between E Lake Washington Boulevard and NE 45th Street				
Northbound	E	14.0	E	11.5
Southbound	F	8.0	F	8.5
NE 45th Street between 5th Avenue NE and Union Bay Place NE				
Eastbound	D	11.7	D	12.0
Westbound	D	12.0	D	11.6
NE Pacific Street (NE Northlake Way) between 6th Avenue NE and Montlake Boulevard E				
Eastbound	D	15.9	C	18.3
Westbound	C	20.6	C	21.9
Roosevelt Way NE between NE Campus Parkway and NE 50th Street				
Southbound	C	14.4	D	10.4
Stevens Way NE between 15th Avenue NE and 25th Avenue NE				
Eastbound	F	3.2	F	3.6
Westbound	F	2.7	F	3.1

1. Level of service
2. Average speed in miles per hour

As shown in Table 4.20 and on Figure 4.17, during the future No Action weekday PM peak hour conditions, most corridors are anticipated to operate at the same LOS as under existing conditions. Exceptions to this would be northbound 11th Avenue NE, eastbound NE Pacific Street, and southbound Roosevelt Way NE. The 11th Avenue NE northbound is anticipated to degrade from LOS E to LOS F; NE Pacific Street eastbound is anticipated to change from LOS D to LOS C; and southbound Roosevelt Way NE is anticipated to degrade from LOS C to LOS D. Improvements in speed between existing and No Action Alternative conditions could be attributed to capital intersection improvements like those at Montlake Boulevard NE, optimized signal timing, ITS improvements, and opportunity for adaptive signal controls in the future. Detailed corridor operations worksheets are provided in Appendix C.



Future (2028) No Action Weekday PM Peak Hour Corridor Traffic Operations

FIGURE

4.17

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4.5.5 Screenline Analysis: Primary Impact Zone

> **Screenline:** An imaginary line across which the number of passing vehicles is counted.

This section describes the screenline analysis completed for two City-designated screenlines within the study area. In this study, screenlines were selected to count vehicle traffic entering and exiting the University of Washington primary and secondary impact zones. As part of the Mayor's Seattle 2035 Comprehensive Plan (City of Seattle, 2016), two screenlines were identified within the University of Washington vicinity, as shown in Figure 4.18. Screenline 5.16 is an east-west screenline that measures north-south travel and extends along the Lake Washington Ship Canal to include the University and Montlake bridges. Screenline 13.13 is a north-south screenline that measures east-west travel and extends east of I-5 between NE Pacific Street and NE Ravenna Boulevard.

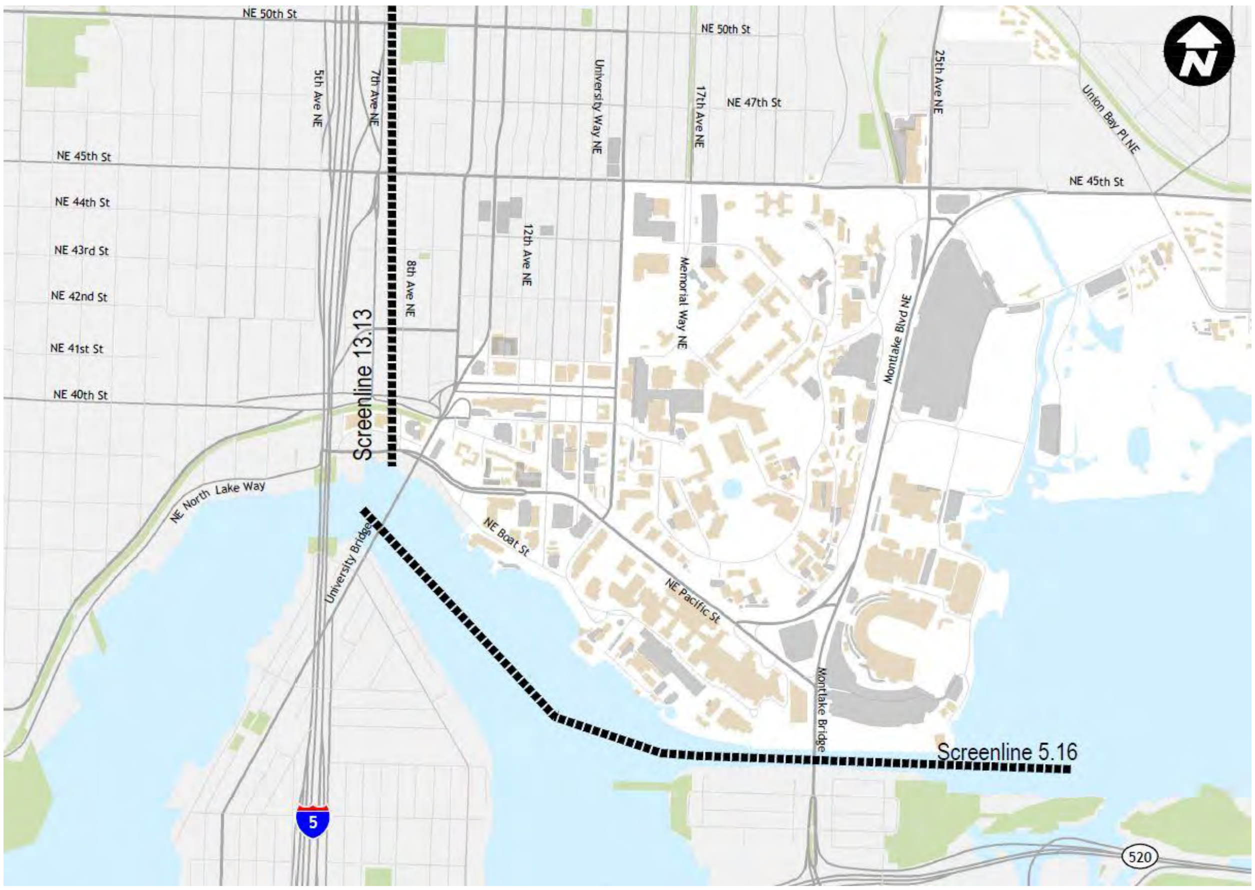


Figure 4.18 Study Area Screenlines

The screenline analysis includes volume-to-capacity (V/C) calculations for the vehicles traversing the screenlines using No Action Alternative traffic volumes and interpolated roadway capacity estimates. Roadway capacity for the 2028 horizon year was interpolated using 2016 capacity estimates described in Chapter 3, Affected Environment, and 2035 capacity estimates referenced in the May 2016 Seattle Comprehensive Plan Update Final EIS. The 2028 No Action roadway capacity estimates are shown in Table 4.21. Detailed screenline volumes and V/C calculations are included in Appendix C.

Table 4.21
ROADWAY CAPACITY AT STUDY AREA SCREENLINES

Screenline	2028 No Action Capacity
5.16 – Ship Canal, University and Montlake Bridges	
Northbound	4,210
Southbound	4,210
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard	
Eastbound	6,119
Westbound	6,119

LOS standards for the screenline analysis are based on the V/C ratio of a screenline. As described in the Seattle Comprehensive Plan Update Final EIS, the LOS standard V/C ratio for Screenlines 5.16 and 13.13 are 1.20 and 1.00, respectively (City of Seattle, 2016). For this study, screenline V/C ratios that do not exceed the LOS standard are acceptable. The No Action Alternative screenline analysis is included in Table 4.22. Detailed screenline analysis calculations are included in Appendix C.

Table 4.22
NO ACTION ALTERNATIVE SCREENLINE ANALYSIS

Screenline	Screenline Volume	Capacity	V/C	LOS Standard V/C
5.16 – Ship Canal, University and Montlake Bridges				
Northbound	3,835	4,210	0.91	1.20
Southbound	4,000	4,210	0.95	1.20
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard				
Eastbound	3,240	6,119	0.53	1.00
Westbound	3,335	6,119	0.55	1.00

Source: NACTO, Seattle Comprehensive Plan Update EIS, and Transpo Group, 2016

As shown in Table 4.22, all No Action Alternative screenline V/C ratios would meet the acceptable LOS standard.

4.5.6 Service/Freight Routes

With the addition of 211,000 gsf of net new development under the No Action Alternative, overall campus service volumes would increase. The percentage increase in freight/service-related traffic would be insignificant given the overall campus volumes, background traffic volumes, and service-related volumes specific to this CMP. Permitting of future campus development projects would require further analysis for the access needs and location, based on the final location, design elements, and programs to be accommodated for each structure.

4.5.7 Parking

This section identifies the No Action Alternative parking impacts. Appendix B Methods and Assumptions describes the methodology for forecasting future parking conditions.

The parking impacts evaluation considered the following:

- Adherence to the City-University Agreement (CUA) parking cap (12,300 spaces)
- Supply and demand forecast for the overall campus as well as within each campus sector
- The potential to exacerbate offsite parking beyond the campus boundaries
- Potential measures to mitigate the potential impacts identified

Parking Supply

As described in Chapter 3, Affected Environment, the current parking supply cap provided on-campus is 10,667 spaces. This analysis assumed future parking supply increases to accommodate additional demands associated with the No Action Alternative's anticipated growth in parking demand. This would result in a slight increase in parking demand but a peak parking utilization (the demand compared to parking supply) of 85 percent for the sector. Development associated with the No Action Alternative is anticipated to occur in the South Campus or West Campus sectors. Therefore, it was assumed that parking supply would increase by 236 spaces because parking utilization for the South Campus sector would be 85 percent. This would result in a future parking supply cap of 10,903 spaces and will not exceed the parking cap of 12,300 spaces.

Parking Demand

Under the No Action Alternative, campus parking demand would increase as a result of the additional 211,000 gsf of development. No Action Alternative parking demand was forecasted based on the increase in campus population consistent with the increase in gsf of development. Table 4.23 summarizes the No Action parking demand compared to existing conditions.

Table 4.23
PEAK PARKING DEMAND COMPARISON

	Vehicles Parked							
	Students[1]		Faculty[1]		Staff[1]		Total	
	Existing[2]	No Action[3]	Existing[2]	No Action[3]	Existing[2]	No Action[3]	Existing[2]	No Action[3]
On-Campus	1,844	1,857	1,090	1,097	3,786	3,814	6,720	6,768
On-Street	134	134	49	49	93	94	276	277
Total	**1,978**	**1,991**	**1,139**	**1,146**	**3,879**	**3,908**	**6,996**	**7,045**

Source: Transpo Group, 2016

1. Demand by population and parking destinations based on 3-year average of University of Washington 2012–2014 Transportation Surveys consistent with information presented in Chapter 3, Affected Environment.
2. Existing parking demand based on University of Washington 2015 parking counts.
3. No Action forecasts based on projected increase in population.

As shown in Table 4.23 a parking demand of less than 50 additional vehicles is expected from the No Action 211,000 gsf development under the 2003 Campus Master Plan. With an increase in parking supply, the No Action Alternative overall campus parking utilization would be slightly less than existing conditions and would not result in a significant adverse impact.

The No Action Alternative on-campus parking demand and utilization was also reviewed by campus sector to provide context on where parking demand would occur. Allocation of No Action Alternative parking demand by sector was based on projected growth by sector. It was assumed that under the No Action Alternative, on-street parking would continue.

Table 4.24
ON-CAMPUS PEAK PARKING DEMAND BY SECTOR

Sector	Future Cap Parking Supply	Parking Demand			% Utilization
		Existing[1]	No Action Growth[2]	No Action Total	
West	1,524	1,428	+48	1,476	96%
South	1,400	1,139	+0	1,139	81%
Central	3,129	2,689	+0	2,689	86%
East	4,853	1,464	+0	1,464	30%
Total	**10,903**	**6,720**	**+48**	**6,768**	**62%**

Source: Transpo Group, 2016

1. Existing parking demand based on University of Washington 2015 parking counts.
2. On-campus parking demand for the No Action Alternative based on projected increase in population. This does not include on-street parking demand increases noted in the Table 4.23 since these would not be parking within the sector lot.

As indicated in Table 4.24, the added parking demand with new South Campus development under the No Action Alternative would result in a 62 percent parking utilization. The West Campus would increase from 94 percent parking utilization under existing conditions to 96 percent. However, given the parking utilization in other campus sectors, portions of this demand could be accommodated elsewhere on campus if it were to become difficult to find parking in West Campus.

With the No Action Alternative, the campus as a whole would still be able to accommodate the total future parking demand within the existing parking supply. Parking could be managed within the established parking cap constraints.

Secondary Parking Impacts

Parking outside the primary impact zone surrounding the campus would likely continue with the No Action Alternative. This would involve students, faculty, and staff parking their vehicles within transit-served areas with unrestricted parking and then using transit and the U-PASS to travel to campus. Given the minimal growth under the No Action Alternative, parking levels would likely be similar to existing conditions.

4.6 TRIP AND PARKING CAPS

4.6.1 Vehicle Trip Caps

As described in Chapter 3, Affected Environment, the University of Washington overall travel demand is subject to maintaining compliance with the trip caps consistent with 1990 University vehicle demand levels. Table 4.25 summarizes the trip cap for the No Action Alternative. No Action assumes that campus population growth would be limited to that associated with completion of the 211,000 gsf building in West Campus, which would reflect a very minor increase in campus-generated traffic above existing levels. As shown, the trip cap would continue to be met, assuming current (2015) mode splits are maintained.

Table 4.25
VEHICLE TRIP CAP SUMMARY

Location/Peak Period	Trip Cap (vph)	No Action
University of Washington Campus		
AM Peak Period Inbound (7:00-9:00)	7,900	7,005
PM Peak Period Outbound (3:00-6:00)	8,500	7,005
U District		
AM Peak Period Inbound (7:00-9:00)	10,100	8,750
PM Peak Period Outbound (3:00-6:00)	10,500	8,750

Note: vph is Vehicles per hour

4.6.2 Parking Caps

With the No Action Alternative, new parking would be provided only to replace parking removed for new buildings.

5 IMPACTS OF ALTERNATIVE 1

This chapter summarizes the results of the analysis conducted for Alternative 1. This evaluation examines the impacts to the key transportation elements and transportation modes identified in Chapter 3, Affected Environment.

The No Action Alternative, used to compare existing conditions to Alternative 1, assumes a proportion of the development to be 211,000 gross square footage (gsf), as included in the development proposed as part of the 2003 Campus Master Plan.

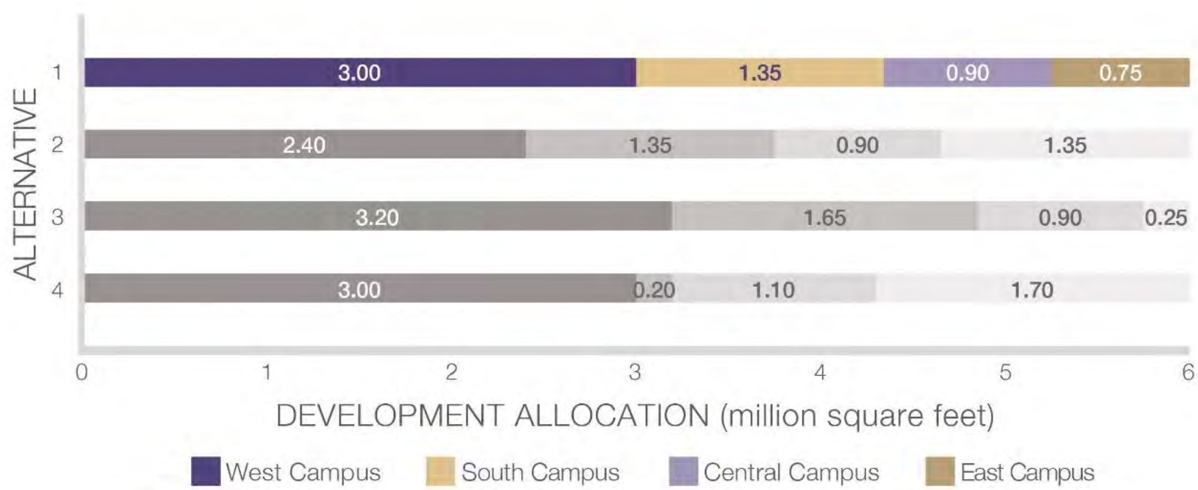
This chapter evaluates all modes of travel and compares **Alternative 1** to the No Action Alternative. Alternative 1 would encompass operations in the horizon year of 2028 with approximately 6 million gross square footage of new development. The focus of those improvements would be primarily in the West and South campus sectors with more limited development in the Central and East campus sectors.

5.1 CHANGING CAMPUS CHARACTERISTICS

5.1.1 Description of the Alternative

The proposed University of Washington development in Alternative 1 is anticipated to be primarily located in the West and South campus sectors. The technical analysis of Alternative 1 focused on the weekday PM peak period and addresses all transportation modes. Alternative 1 represents the University's preferred alternative.

Alternative 1 would include the development of 6 million net new gsf throughout the campus with a focus in the West and South campus sectors. Of this total, approximately 3 million gsf would be located in West Campus and 1.35 million gsf in South Campus. More limited development is planned for the Central and East campus sectors, approximately 900,000 gsf and 750,000 gsf, respectively, as shown in Figure 5.1.



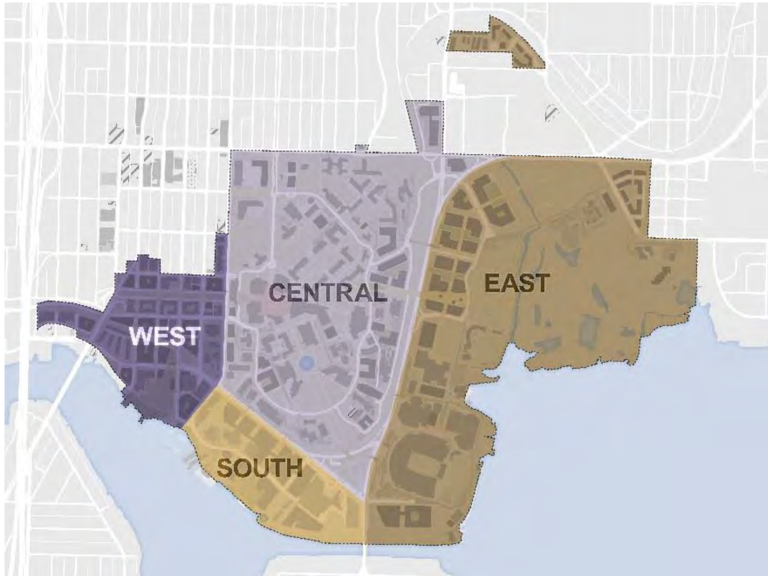


Figure 5.1 Alternative 1 Development Allocation

5.1.2 Trip Generation by Mode

This section provides a summary of the anticipated trip generation for pedestrian, bicycle, transit, and vehicle modes to campus. The trip generation methodology used for assessing the increase in trips under Alternative 1 is consistent with that previously described in Chapter 4, Impacts of No Action. The increase in trips anticipated with Alternative 1 was compared against the No Action forecasts to determine the net increase associated with population growth.

Weekday daily, AM, and PM peak hour vehicular trip generation, comprising both drive alone vehicles and carpools, is summarized in Table 5.1.

Table 5.1
ESTIMATED VEHICLE TRIPS (WEEKDAY)

Trip Type	Daily Trips	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
No Action Alternative							
Student	8,710	1,485	635	2,120	670	955	1,625
Faculty	6,880	1,465	630	2,095	1,035	1,470	2,505
Staff	12,260	3,190	1,370	4,560	1,885	2,685	4,570
Total No Action	**27,850**	**6,140**	**2,635**	**8,775**	**3,590**	**5,110**	**8,700**
Alternative 1							
Student	10,390	1,775	760	2,535	800	1,140	1,940
Faculty	8,230	1,750	750	2,500	1,240	1,765	3,005
Staff	14,860	3,860	1,660	5,520	2,280	3,250	5,530
Total Alternative 1	**33,480**	**7,385**	**3,170**	**10,555**	**4,320**	**6,155**	**10,475**
Net New Trips							
Student	1,680	290	125	415	130	185	315
Faculty	1,350	285	120	405	205	295	500
Staff	2,600	670	290	960	395	565	960
Total Net New Trips	**5,630**	**1,245**	**535**	**1,780**	**730**	**1,045**	**1,775**

Source: Transpo Group, 2016

The table shows that the University-associated development is anticipated to generate 5,630 net new daily trips with approximately 1,780 occurring during the AM peak hour and 1,775 during the PM peak hour. Weekday daily, AM, and PM peak hour vehicular trip generation accounting for visitors is summarized in Table 5.2.

Table 5.2
ESTIMATED NET NEW VEHICLE TRIPS

Trip Type	Daily Trips	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Net New Trips							
Student	1,680	290	125	415	130	185	315
Faculty	1,350	285	120	405	205	295	500
Staff	2,600	670	290	960	395	565	960
Total Net New Trips	**5,630**	**1,245**	**535**	**1,780**	**730**	**1,045**	**1,775**
Visitors (10%)	565	125	55	180	75	105	180
Total UW Trips	**6,195**	**1,370**	**590**	**1,960**	**805**	**1,150**	**1,955**

Source: Transpo Group, 2016

Table 5.3 summarizes trip generation by mode, including transit, walk, bicycle, and other trips with Alternative 1.

Table 5.3
ESTIMATED DAILY TRIPS BY MODE

Trip Type	Transit	Walk	Bicycle	Other
No Action Alternative				
Student	34,550	28,270	5,500	470
Faculty	2,990	840	1,680	260
Staff	11,790	1,120	2,110	670
Total No Action	**49,330**	**30,230**	**9,290**	**1,400**
Alternative 1				
Student	40,480	33,120	6,440	550
Faculty	3,450	960	1,930	300
Staff	15,460	1,470	2,760	870
Total Alternative 1	**59,390**	**35,550**	**11,130**	**1,720**
Net New Trips				
Student	5,930	4,850	940	80
Faculty	460	120	250	40
Staff	3,670	350	650	200
Total Net New Trips	**10,060**	**5,320**	**1,840**	**320**

Source: Transpo Group, 2016

As shown in the table, the proposed development is anticipated to generate 10,060 net new daily transit trips, 5,320 walking trips, 1,840 bicycle trips, and 320 other trips.

5.2 PEDESTRIANS

5.2.1 Performance Measures

The following pedestrian-related performance measures have been identified to assess and compare alternatives:

- Proportion of development within 1/4 mile of multifamily Housing
- Proportion of development within 1/4 mile of University of Washington Residence Halls
- Quality of pedestrian environment
- Pedestrian Screenline Demand and Capacity
- Pedestrian Transit Station/Stop Area LOS

These measures reflect the effectiveness of the pedestrian network in providing safe and easy access to pedestrian destinations, specifically housing, thereby maintaining a high walk mode choice on-campus. A comparisons between Alternative 1 relative to the No Action Alternative is provided for each measure below.

Proportion of Development Within 1/4 Mile of Multifamily Housing

Walking makes up nearly one-quarter of all existing trips to and from campus. Proximity of campus development to housing is therefore one important measure to assessing the propensity of people to walk. This measure assesses the proximity of the current campus buildings and development to nearby multifamily housing. As shown in oximity to multifamily housing.

Table 5.4, 60 percent of Alternative 1 development would be within a 1/4 mile proximity to multifamily housing.

Table 5.4
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF MULTIFAMILY HOUSING

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)
West	211,000	3,000,000
South	NA	0
Central	NA	589,985
East	NA	0
Total	**NA**	**3,589,985**
Percent	***100%***	***60%***

Proportion of Development Within 1/4 Mile of University of Washington Residence Halls

This performance measure assesses the proximity of campus development within walking distance of residence halls. For this analysis, University of Washington residence halls were identified and then buffered by 1/4 mile. As shown in Table 5.5, 80 percent of the new development would be within a 1/4 mile proximity to residence halls.

Table 5.5
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RESIDENCE HALLS

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)
West	211,000	3,000,000
South	NA	249,344
Central	NA	798,357
East	NA	750,000
Total	**211,000**	**4,797,701**
Percent	***100%***	***80%***

Quality of Pedestrian Environment (Primary and Secondary Impact Zones)

Alternative 1 would provide a number of quality enhancements to pedestrian travel within the Major Institution Overlay (MIO) where development would occur. This alternative includes new waterfront open space in West Campus and South Campus with several new pedestrian facilities in and surrounding this green. The Campus Master Plan (CMP) identifies a new Americans with Disabilities Act (ADA) accessible east-west connection between the new green to Central Campus, thereby improving accessibility and providing an alternative route to the currently heavily used NE 40th Street/Grant Lane route. Pedestrian demand in and around West Campus would increase with added uses.

The CMP also identifies a number of new pedestrian connections in South Campus. These improvements would better connect Portage Bay with Central Campus. Compared to the No Action Alternative, Alternative 1 would greatly improve pedestrian circulation.

In addition to these upgrades, the City of Seattle's Pedestrian Master Plan highlights new Neighborhood Greenways within the primary and secondary impact zones.

Within the primary impact zone, several greenways are planned in the following locations:

- A southern extension of the existing 12th Avenue NE Neighborhood Greenway
- Walla Walla Road
- NE Boat Street from NE Pacific Street to 15th Avenue NE, which would improve pedestrian connectivity from the Cheshiahud Lake Union Loop to the University of Washington campus.
- 20th Avenue NE north of 45th Street and NE 47th Street west of 20th Ave NE, which would increase pedestrian connectivity to the secondary impact zone, and connect to other planned greenways including 11th Avenue NE, NE 55th Street, and NE 62nd Street.
- NE Clark Road

Within the secondary impact zone, greenways in the east section are planned in the following locations:

- 5th Avenue NE
- NE 46th Street
- Keystone Place N

And in the west section:

- NE Surber Drive
- NE 50th Street

Pedestrian Screenline Capacity

The pedestrian screenline capacity analysis evaluates the peak hour demand, capacity, and level of service (LOS) at all at-grade and above-grade crossing locations along Montlake Boulevard NE, NE Pacific Street, 15th Avenue NE, and NE 45th Street. The following section summarizes pedestrian screenline volumes in Alternative 1.

Pedestrian Growth From Transit Ridership

Pedestrian growth from increased transit ridership was added to transit stop pedestrian volumes aggregated by screenline. This growth accounts for all new pedestrians in the University of Washington study area that would be generated by the 10,310 net new transit trips to and from campus under Alternative 1, as noted in Table 5.3 above. During evaluation, a percentage of these trips was allocated to each campus sector (West, South, Central, and East) based on anticipated future transit service from King County METRO CONNECTS and Sound Transit Link light rail extensions, and applied to aggregate screenline pedestrian volumes. Peak hour pedestrian growth from transit ridership is summarized in Table 5.6.

Table 5.6
PEAK HOUR PEDESTRIAN GROWTH FROM TRANSIT RIDERSHIP

Screenline	Pedestrian Volume from Transit Riders (People/hour)
Montlake Boulevard NE	754
NE Pacific Street	168
15th Avenue NE	1,675
NE 45th Street	0

Source: Transpo Group, 2017

As shown in Table 5.6, the 15th Avenue NE screenline would experience the greatest increase of pedestrian crossings from transit. This is due to the implementation of the University District (U District) Station (Link light rail). All transit riders from this station would cross 15th Avenue NE to reach campus. The NE 45th Street screenline would not experience pedestrian growth from transit ridership because no transit stops would be located on NE 45th Street in the area analyzed (between 15th Avenue NE and 20th Avenue NE). Therefore, the crossings analyzed—at 15th Avenue NE, 17th Avenue NE, 18th Avenue NE, 19th Avenue NE, and 20th Avenue NE—are not assumed to be impacted by increased transit riders.

Pedestrian Growth From Alternative 1 Development

Pedestrian growth anticipated with Alternative 1 was assumed to be relative to the No Action Alternative. This growth is based on the proportion of development from Alternative 1 in each campus sector (West, South, Central, and East), therefore, each transit stop location was grouped by campus sector to calculate its proportional increase. Table 5.7 summarizes peak hour pedestrian screenline volume and LOS.

Table 5.7
PEAK HOUR PEDESTRIAN SCREENLINE VOLUME AND LEVEL OF SERVICE

Screenline	No Action Alternative		Alternative 1	
	Peak Hour Pedestrian Volume (People/hour)	Level of Service (LOS)	Peak Hour Pedestrian Volume (People/hour)	Level of Service (LOS)
Montlake Boulevard NE	14,770	A	17,008	A
NE Pacific Street	3,744	A	4,918	A
15th Avenue NE	12,078	A	16,629	A
NE 45th Street	2,272	A	2,614	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

As shown in Table 5.7, Alternative 1 peak hour aggregate pedestrian volumes for all screenlines would be at LOS A.

Pedestrian Transit Stop Space Analysis

This measure evaluates the peak hour demand, capacity, and LOS at key transit stops along Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE. The following sections summarize the pedestrian space per person and LOS at these locations with Alternative 1 development.

Pedestrian Growth From Transit Ridership

Conservative estimates of growth from increased transit ridership were added to transit stop pedestrian volumes aggregated by campus sector. This growth accounts for all new pedestrians in the University of Washington study area that would be generated from the 10,310 net new transit trips to and from campus under Alternative 1, as noted in Table 5.3 above. During evaluation, a percentage of these trips was allocated to each campus sector (West, South, Central, and East) based on anticipated future transit service from King County METRO CONNECTS and Sound Transit Link light rail extensions. Approximately 15 percent of the aggregated campus sector growth was applied to each transit stop. Peak hour pedestrian growth from transit ridership is summarized in Table 5.8.

Table 5.8
PEAK HOUR PEDESTRIAN GROWTH FROM TRANSIT RIDERSHIP

Stop Location	Stop ID Number	King County Metro Stop Number	Campus Sector	Pedestrian Volume from Transit Riders (People/hour)
NE Pacific Street Bay 1	1	29247	South	126
NE Pacific Street Bay 2	2	29405	South	126
NE Pacific Street at 15th Avenue NE	3	29240	South	126
15th Avenue NE at Campus Parkway	4	29440	West	251
15th Avenue NE at NE 42nd Street	5	11352	West	251
15th Avenue NE at NE 43rd Street	6	10912	West	251
Montlake Boulevard Bay 4	7	25240	East	13
Montlake Boulevard Bay 3	8	25765	East	13
Stevens Way at Pend Oreille Road	9	75410	East	13
Stevens Way at Benton Lane	10	75403	East	13

As shown in Table 5.8, West Campus would experience the greatest increase of pedestrian activity from transit. This is due to the implementation of the U District Station. All transit stop locations in this evaluation were assumed to be impacted primarily by West, South, and East Campus development; therefore, Central Campus was not analyzed.

Pedestrian Growth from Alternative 1 Development

Pedestrian space anticipated for Alternative 1 was assumed to be relative to the No Action Alternative. This growth is based on the proportion of development from Alternative 1 in each campus sector (West, South, Central, and East), therefore, each transit stop location was grouped by campus sector to calculate its proportional increase. Table 5.9 summarizes Alternative 1 peak hour pedestrian space and LOS.

Table 5.9
PEAK HOUR TRANSIT STOP PEDESTRIAN SPACE AND LEVEL OF SERVICE

Stop Location	Stop ID Number	No Action Alternative		Alternative 1	
		Pedestrian Space (ft^2/person)	Level of Service (LOS)	Pedestrian Space (ft^2/person)	Level of Service (LOS)
NE Pacific Street Bay 1	1	45.0	A	10.9	B
NE Pacific Street Bay 2	2	39.0	A	10.4	B
NE Pacific Street at 15th Avenue NE	3	7.5	C	1.7	F
15th Avenue NE at Campus Parkway	4	62.4	A	8.3	C
15th Avenue NE at NE 42nd Street	5	50.5	A	6.5	D
15th Avenue NE at NE 43rd Street	6	27.8	A	7.1	C
Montlake Boulevard Bay 4	7	39.0	A	24.3	A
Montlake Boulevard Bay 3	8	108.7	A	67.9	A
Stevens Way at Pend Oreille Road	9	19.0	A	12.2	B
Stevens Way at Benton Lane	10	36.4	A	23.7	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

As shown in Table 5.9, Alternative 1 peak hour pedestrian space for all transit stops, with the exception of locations 3 and 5, would be at LOS C or better. Location 3 (mid-block near the 15th Avenue NE/ NE Pacific Street intersection) and location 5 (at the 15th Avenue NE/ NE 42nd Street intersection) would be at LOS F and LOS D, respectively.

5.3 BICYCLES

5.3.1 Performance Measures

The following bicycle-related performance measures have been identified to assess and compare alternatives:

- Burke-Gilman Trail Capacity
- Bicycle Parking and Utilization
- Quality of Bicycle Environment

Burke-Gilman Trail Capacity

The Burke-Gilman Trail is anticipated to experience increased demand throughout all sectors of campus, but particularly in West and South Campus. The focus on development in West Campus with Alternative 1 could result in trail facility improvements, similar to those in the Mercer Court area. Increased cross traffic and travel along the newly updated trail segment is anticipated in South Campus with Alternative 1 development. As noted in Chapter 4, planned expansion of the Burke-Gilman Trail to separate pedestrian and bicycle uses would provide adequate capacity to meet future CMP demands. A portion of the trail from West of the University Bridge to Rainier Vista was improved in 2016 according to the plan; however, the section from Rainier Vista to North of Pend Oreille Road remains unfunded.

Cross traffic and travel along the older segment of the trail would increase in East Campus. Existing travel patterns from the Pronto Cycle Share program (discontinued as of March 31, 2017) suggest that East Campus bicycle travel may increase in the future, as the Burke-Gilman Trail provides a flat and direct route from East Campus to the South and West campus sectors.

As described previously, Burke-Gilman Trail level of service was evaluated with methods used in the 2011 and 2012 studies, including the use of the Federal Highway Administration's Shared-Use Path Level of Service Calculator (SUPLOS). SUPLOS evaluates trail segments using factors including trail width, directional bicycle and pedestrian volumes, and the presence of a striped centerline. (University of Washington Burke-Gilman Trail Corridor Study, July 2011). Future Alternative 1 level of service includes 2028 projected weekday PM peak hour pedestrian and bicycle counts in the operational analysis. In addition, a 20 percent increase over the existing (2010) volumes provided in the July 2011 study was included to account for development growth. The Future Alternative 1 weekday PM peak hour level of service along trail segments is summarized below. Additional detail on the operational analysis can be found in the Methods & Assumptions Appendix.

Table 5.10

FUTURE (2028) ALTERNATIVE 1 BURKE-GILMAN TRAIL WEEKDAY PM PEAK HOUR LEVEL OF SERVICE

Location	2028 Alt 1 Projected Pedestrian Volume	2028 Alt 1 Projected Bicycle Volume	Combined Trail		Separated Trail	
			Level of Service (LOS) Score	Level of Service (LOS) Grade	Level of Service (LOS) Score	Level of Service (LOS) Grade
West of University Bridge	286	1,311	NA	NA	4.13	A
West of 15th Avenue NE	391	1,537	NA	NA	4.11	A
Hitchcock Bridge	682	1,549	NA	NA	4.07	A
T-Wing Overpass	835	1,549	NA	NA	4.22	A
Rainier Vista West	417	1,510	1.37	F	3.82	B
Hec Edmundson Bridge	462	1,525	1.18	F	3.72	B

Location	2028 Alt 1 Projected Pedestrian Volume	2028 Alt 1 Projected Bicycle Volume	Combined Trail		Separated Trail	
			Level of Service (LOS) Score	Level of Service (LOS) Grade	Level of Service (LOS) Score	Level of Service (LOS) Grade
Wahkiakum Lane	309	1,375	0.72	F	3.43	C
South of Pend Oreille Road NE	276	1,418	0.73	F	3.40	C
North of Pend Oreille Road NE	334	1,408	0.58	F	3.39	C

As indicated in the July 2011 corridor study, a combined trail for both pedestrian and bicycle modes results in a much lower level of service than a separated trail. Level of service along the Burke-Gilman Trail can be improved as the plan is implemented to separate the trail.

Bicycle Parking and Utilization

As described in the Affected Environment chapter, the University has effectively managed bicycle parking demand. As new buildings are constructed, bicycle parking will be provided. For these reasons, additional bicycle parking analysis was not conducted for any of the growth alternatives (Alternatives 1-4).

Quality of Bicycle Environment (Primary and Secondary Impact Zones)

The quality of bicycle travel associated with Alternative 1 generally would improve in areas with development. This primarily would include new or improved dedicated bicycle facilities in West and South Campus, or in the case of East Campus, improved access to the Burke-Gilman Trail. South Campus could see the largest improvement in internal circulation and improved access to Portage Bay.

In addition to those mentioned above, the Seattle Bicycle Master Plan includes several proposed improvements within the primary and secondary impact zones.

Within the primary impact zone, planned improvements include:

- A protected bike lane running north-south along Roosevelt Way NE highlights bicycle connectivity improvements (recently installed)
- Protected bike lanes along 11th Avenue NE and 12th Avenue NE
- Protected bike lanes along NE 40th Street, west of Brooklyn Avenue NE that would connect with the existing cycling infrastructure on NE 40th Street, thereby improving connectivity to campus

Within the secondary impact zone, planned improvements include:

- A new protected bike lane along Ravenna Place NE that would provide a direct connection between the Burke-Gillman Trail and Ravenna Park
- A protected bike lane along 36th Avenue NE that would increase bicycle connectivity in the north/south directions

- A planned Neighborhood Greenway along Fairview Avenue E that would increase the cycle connection to campus from the south

In general, bicycle travel demand would increase throughout these areas as well as on regional bicycle facilities to/from them; however, capacity constraints are not anticipated overall but select locations of the Burke-Gilman Trail may be constrained. Bicycle travel on Central Campus would grow but by a relatively small amount compared to existing travel demand. Also, limited improvements in dedicated bicycle facilities in Central Campus would be expected.

5.4 TRANSIT

5.4.1 Performance Measures

The following transit-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development Within 1/4 Mile of RapidRide
- Proportion of Development Within 1/2 Mile of Light Rail
- Transit Stop Capacity
- Transit Travel Times and Delay
- Transit Loads at Screenlines

Proportion of Development Within 1/4 Mile of RapidRide

This measure calculates the proportion of development within 1/4 mile of RapidRide service to the University of Washington. As shown in Table 5.11 below, 100 percent of the new development in Alternative 1 would be within 1/4 mile proximity of RapidRide.

Table 5.11
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RAPIDRIDE

Sector	No Action Gross Square Footage (gsf)	Alternative 1 Gross Square Footage (gsf)
West	211,000	3,000,000
South	NA	1,350,000
Central	NA	900,000
East	NA	750,000
Total	**211,000**	**6,000,000**
Percent	***100%***	***100%***

Proportion of Development Within 1/2 Mile of Light Rail

This measure evaluates the proportion of development within a 1/2 mile walkshed of light rail stations. This action includes the U District Station at Brooklyn Street between NE 45th and NE 43rd streets, assumed to be completed in 2021. Table 5.12 summarizes the square footage of development within a 1/2 mile walkshed of light rail. Due to the majority of development in Alternative 1 occurring in the West and South campus sectors, the new development would be 95-percent covered within the 1/2 mile walkshed.

Table 5.12
PROPORTION OF DEVELOPMENT WITHIN 1/2 MILE OF LIGHT RAIL

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)
West	211,000	2,680,232
South	NA	1,350,000
Central	NA	900,000
East	NA	750,000
Total	**211,000**	**5,680,232**
Percent	***100%***	***95%***

Transit Stop Capacity
This measure evaluates the number of buses that a transit stop can process in an hour. This analysis was performed for four pairs of stops on key transit corridors around the University of Washington: 15th Avenue NE, NE 45th Street, Montlake Boulevard and Pacific Street. The transit stop capacity and demand do not change by alternative. Therefore, the summary provided in Chapter 4, Impacts of No Action, reflects the expected operations.

Transit Travel Times and Delay
This measure evaluates the PM peak hour bus transit travel speeds on key corridors around and on the University of Washington campus with the 10,060 net new transit riders assumed for Alternative 1 (see Table 5.3). While each Development Alternative allocates growth to different campus sectors, for this analysis, it was assumed that campus transit patrons would be apportioned to the major transit stops throughout the campus and that transit travel speeds would be effected by an increase in transit patrons and resulting dwell times. For this reason, this transit measure is the same for all development alternatives. Also, it was assumed that, with new light-rail stations opening, many transit patrons would use light rail. Bus transit travel time was evaluated along these corridors:

- NE 45th Street
- Pacific Street
- 11th Avenue NE
- Roosevelt Way NE
- 15th Avenue NE
- Montlake Boulevard NE
- Stevens Way NE

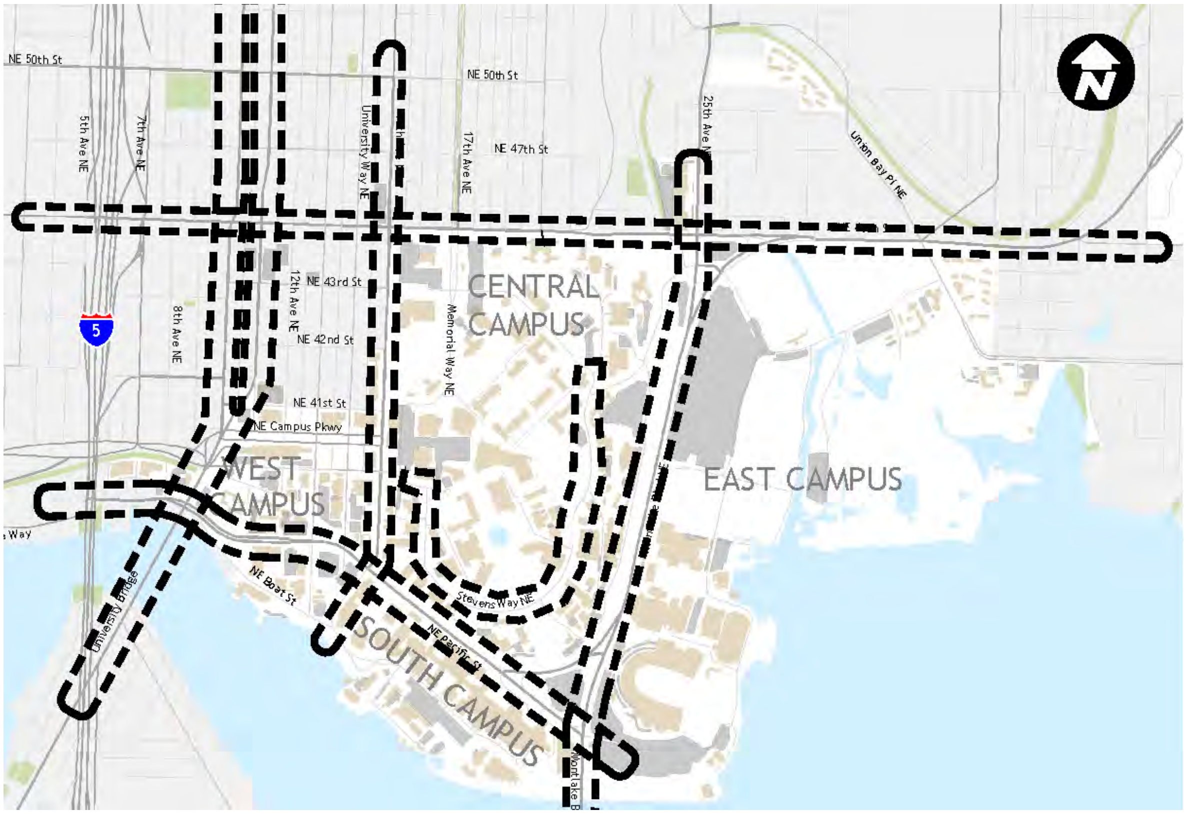


Figure 5.2 Transit Study Corridors

Transit Speed Methodology

To forecast transit speeds, the difference in travel speeds between the No Action Alternative and Alternative 1 (from Synchro traffic models) was added to the No Action transit speeds and new dwell times were calculated based on increased riders from new development. The Alternative 1 average number of passenger boardings and alightings at each stop was calculated from the No Action Alternative. The result was added to the number of forecasted transit trips generated by development. Given the volume of passengers boarding and alighting at each station, a dwell time of 2.75 seconds per boarding and 2.5 seconds per alighting was used to compute the forecast dwell conditions.

In summary, the Campus Master Plan Alternative 1 Transit Speed = No Action Transit Speeds + (Alternative 1 Vehicle Speeds – No Action Vehicle Speeds) + (Alternative 1 Dwell Time – No Action Dwell Time).

Table 5.13 summarizes the Alternative 1 transit travel speeds and compares them to the existing and No Action Alternative transit speeds.

Table 5.13
COMPARISON OF TRANSIT SPEEDS

Corridor	Existing Transit Speed (mph)	No Action Transit Speed (mph)	Alternative 1 Transit Speed (mph)
NE 45th Street Eastbound	5.2	4.8	4.0
NE 45th Street Westbound	5.2	4.0	3.2
NE Pacific Street Eastbound	14.7	12.3	4.6
NE Pacific Street Westbound	7.3	18.3	13.8
11th Avenue NE Northbound	5.9	5.1	4.3
Roosevelt Way NE Southbound	12.6	4.9	4.6
15th Avenue NE Northbound	7.8	14.1	11.3
15th Avenue NE Southbound	5.8	6.8	4.4
Montlake Boulevard NE Northbound	20.0	15.1	11.3
Stevens Way NE Eastbound	6.8	8.8	8.0
Stevens Way NE Westbound	2.7	3.0	3.0

As shown, NE Pacific Street Eastbound results in the largest reduction in travel speed as compared to No Action due to increase dwell times and increased congestion.

Transit Loads at Screenlines

Alternative 1 trips generated by planned University of Washington development were added to the future (2028) baseline demand totals at transit screenlines. These new trips were based on the Pedestrian Screenline Analysis found above in Section 5.4.1, Performance Measures, and used the same pedestrian screenlines. New trips found at pedestrian screenlines were allocated to transit screenlines based on trip distribution assumed in the 2018 CMP and the directionality of routes served on the screenline.

Transit screenline demand-to-capacity (D/C) rates were calculated at both the individual and aggregated level to determine the network's effectiveness at servicing future demand. Consistent with the No Action Alternative, capacity issues are anticipated at the screenlines at 11th Avenue NE south of NE 45th Street, and University Way south of NE 43rd Street. These screenlines would operate at a utilization of over 100 percent, meaning insufficient capacity would exist. These two screenlines are not anticipated to be primary routes for campus-related trips so demand and capacity is expected to be similar to the No Action Alternative. Similar to transit travel times, this transit measure is the same for all development alternatives.

Screenline D/C for Alternative 1 is shown in Table 4.15 below. Looking in the aggregate at all bus service and all demand, bus D/C would be 51 percent, and total Link light rail D/C would be 73 percent, with 67 percent overall D/C across all modes and screenlines. For this 10-year horizon look at bus crowding, the results of this analysis suggest some service would be more crowded and some less crowded but the aggregate demand over all of the screenlines can be accommodated. Transit users at the screenlines that would be over capacity during the PM peak hour could shift to other screenlines as the screenline approached capacity or service can be adjusted.

Table 5.14
TRANSIT SCREENLINE DEMAND AND CAPACITY

Screenline Number	Location	Alt 1 Capacity	Alt 1 Demand	Change from No Action	Alt 1 D/C
1	NE 45th St W/O Mary Gates Drive	2,430	983	328	40%
2	NE 45th & Roosevelt Way	1,040	831	221	80%
3	Roosevelt Way S/O NE 45th St	325	121	-	37%
4	11th Ave NE S/O NE 45th St	325	216	-	67%
5	15th Ave NE S/O NE 43rd St	4,200	1,591	507	38%
6	University Way S/O NE 43rd St	650	516	57	79%
7	Campus Pkwy E/O Brooklyn Ave	1,210	1,159	164	96%
8	Pacific St E/O 15th Ave NE	4,140	1,354	385	33%
9	Stevens Way at Pend Oreille	1,860	1,216	41	65%
10	Montlake Bridge	2,270	1,447	352	64%
11	University Bridge	1,380	757	33	55%
12	Montlake Blvd	730	570	237	78%
Bus Total		**19,830**	**10,245**	**2,088**	**51%**
Link A	U-District Station	23,400	17,305	1,030	74%
Link B	UW/Stadium Station	23,400	16,864	589	72%
Link Total		**46,800**	**34,169**	**1,619**	**73%**
Grand Total		**66,630**	**44,360**	**3,707**	**67%**

5.5 VEHICLE

5.5.1 Performance Measures

Six measures of effectiveness were analyzed to evaluate the impact of the campus growth on the surrounding transportation network:

- Intersection operational level of service for intersection located in the primary and secondary impact area
- Arterial Corridor Operations

- Screenline Volumes
- Cordon Volumes
- Caps are set as 1990 trip levels to the University District and University (MIO)
- Freight Corridor Impact

These measures respond to these questions:

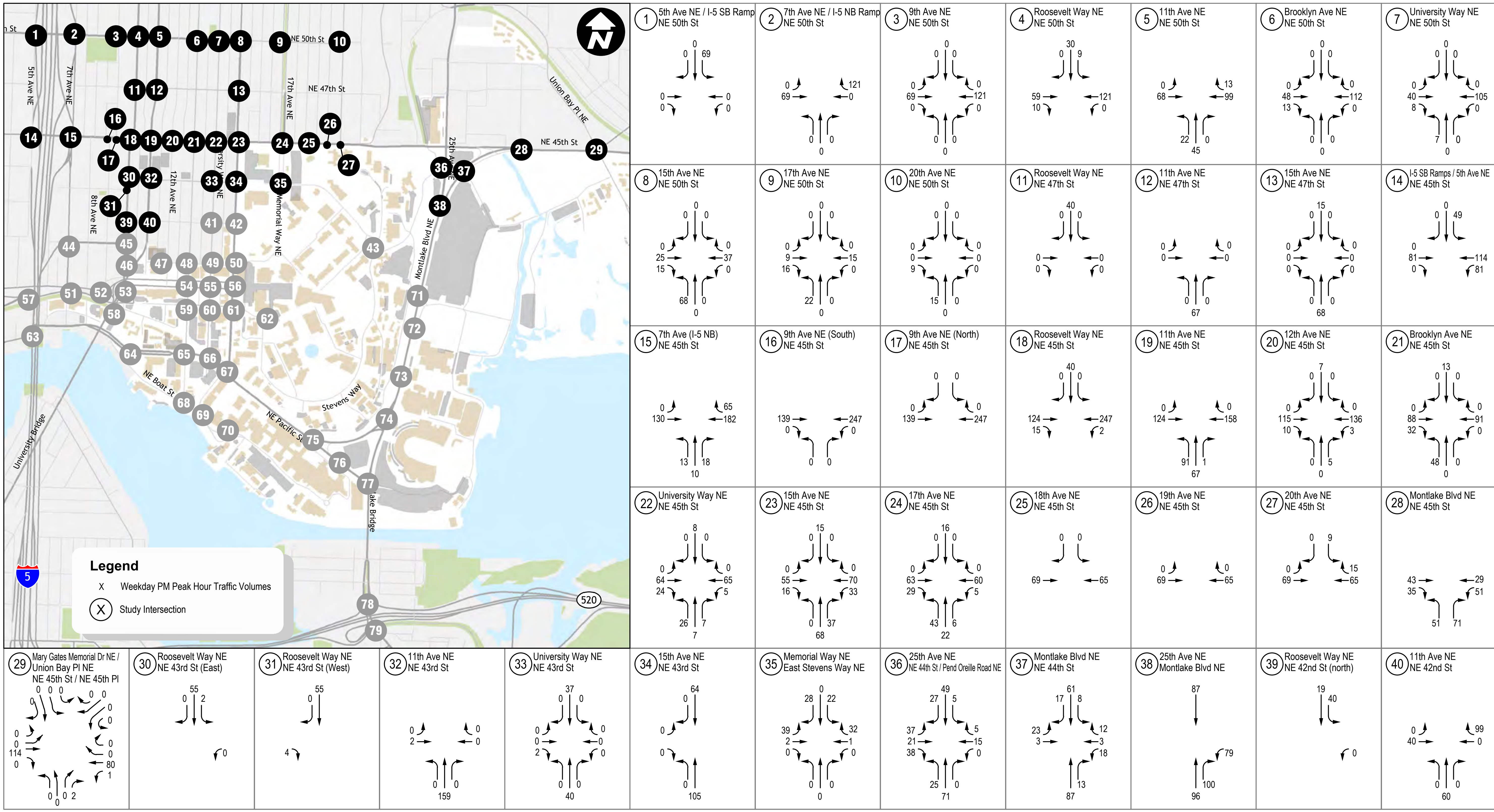
- Will the CMP increase vehicle congestion and will intersections and corridor speeds worsen?
- How will screenlines identified in the comprehensive plan increase?
- How will traffic grow in the overall area?

5.5.2 Traffic Volumes

Increased vehicle traffic associated with Alternative 1 was assigned to potential garage locations based on existing vehicle travel patterns, previous studies in the project vicinity, review of University information, and U.S. Census Bureau's *OnTheMap* tool. *OnTheMap* is a web-based mapping and reporting application that shows where workers are employed and where they live based on census data. The ZIP codes within that data were evaluated to determine if a person would be more likely to travel from the ZIP code via vehicle or by other means. Individuals making trips to ZIP codes closer to the proposed project sites or in more transit-oriented locations are more likely to use transit, walk, bicycle, or use other non-drive alone modes. Individuals making trips to ZIP codes outside the Seattle city limits and/or farther from the site are more likely to drive. The general trip distribution to/from the University of Washington is shown in Chapter 4, Impacts of No Action.

Primary Impact Zone

Project trips for each potential garage location were assigned to the study intersections based on the general trip distribution patterns shown in Chapter 4, Impacts of No Action. Project trips at each study intersection are shown in Figure 5.3 and Figure 5.4 below. The resulting Alternative 1 volumes are shown on Figure 5.5 and Figure 5.6.



Future (2028) Alternative 1 (Intersections 1-40) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE **5.3**

transpogroup WHAT TRANSPORTATION CAN BE.

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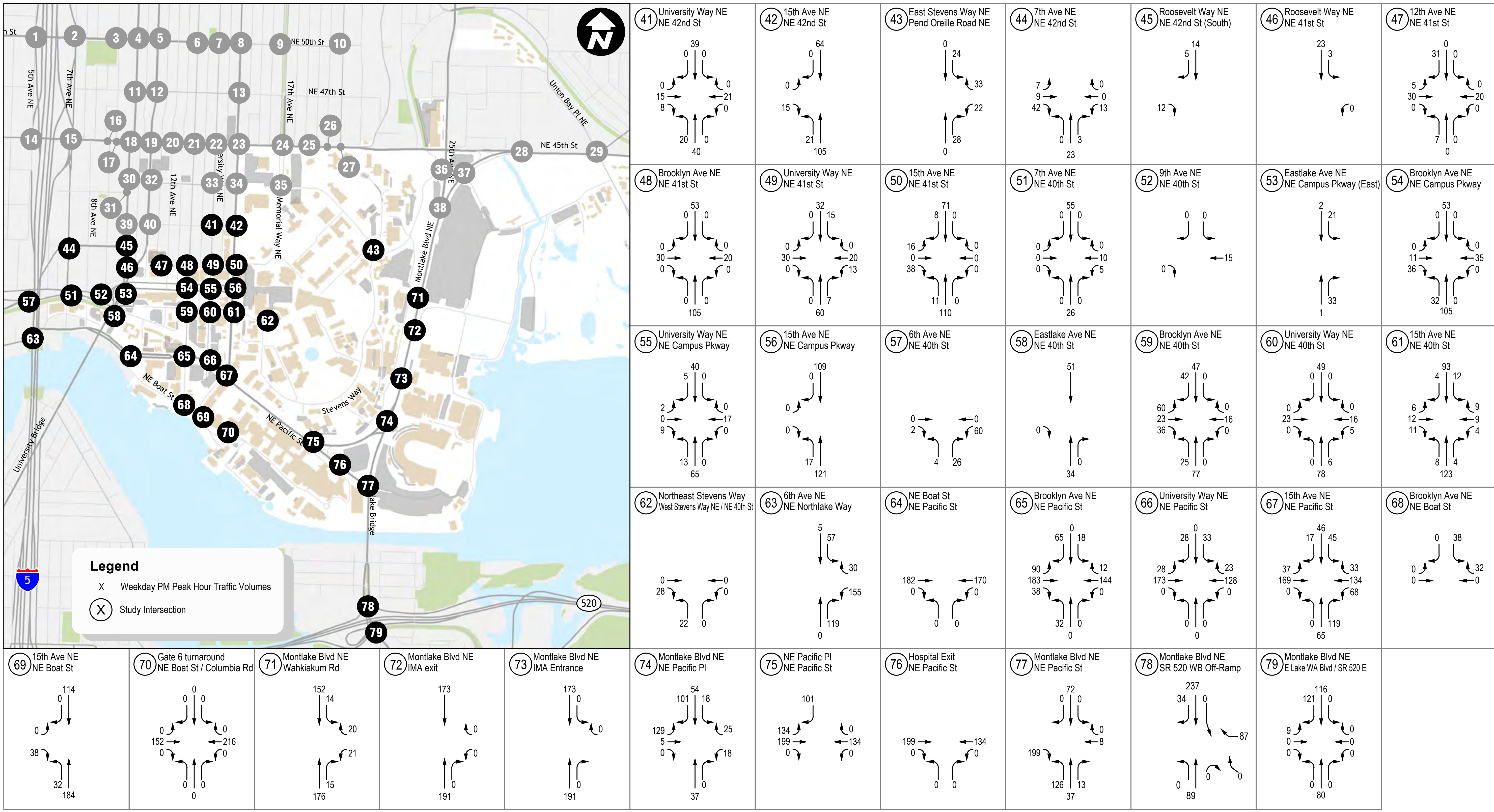

Future (2028) Alternative 1 (Intersections 41-79) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE
5.4

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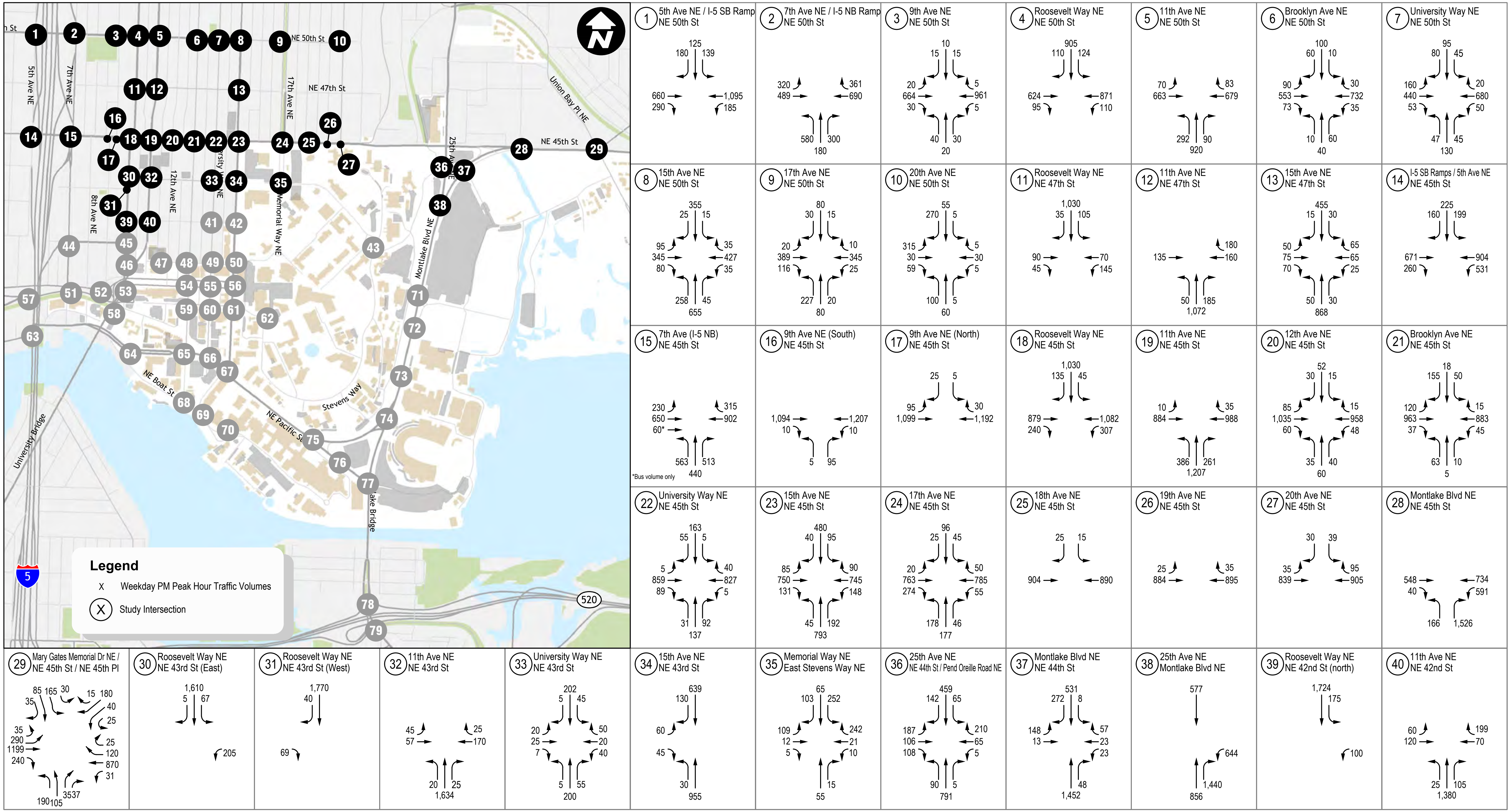
WHAT TRANSPORTATION CAN BE.



Future (2028) Alternative 1 (Intersections 1-40) Weekday PM Peak Hour Traffic Volumes

FIGURE 5.5

University of Washington 2018 Campus Master Plan

transpogroup WHAT TRANSPORTATION CAN BE.

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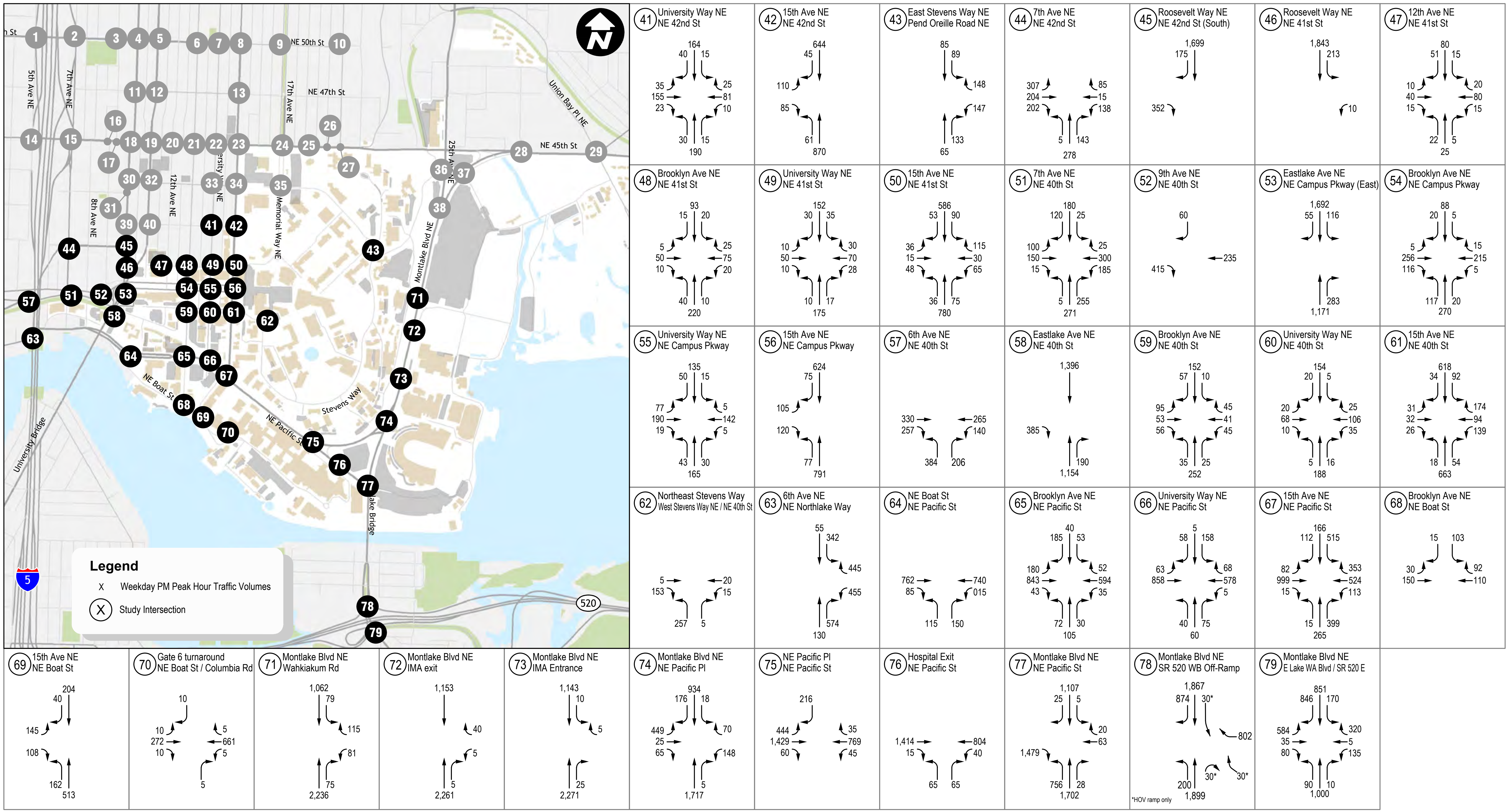


Future (2028) Alternative 1 (Intersections 41-79) Weekday PM Peak Hour Traffic Volumes

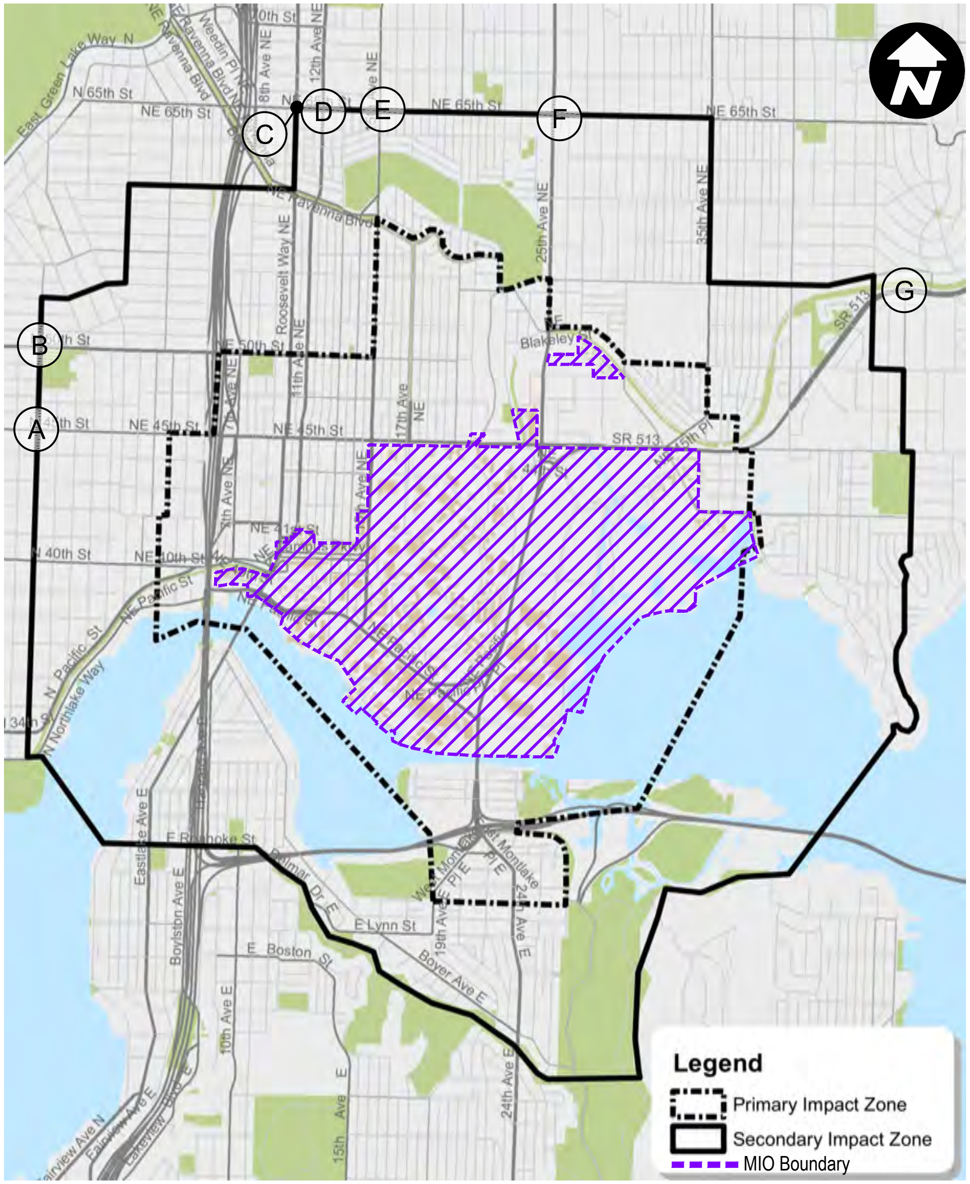
University of Washington 2018 Campus Master Plan

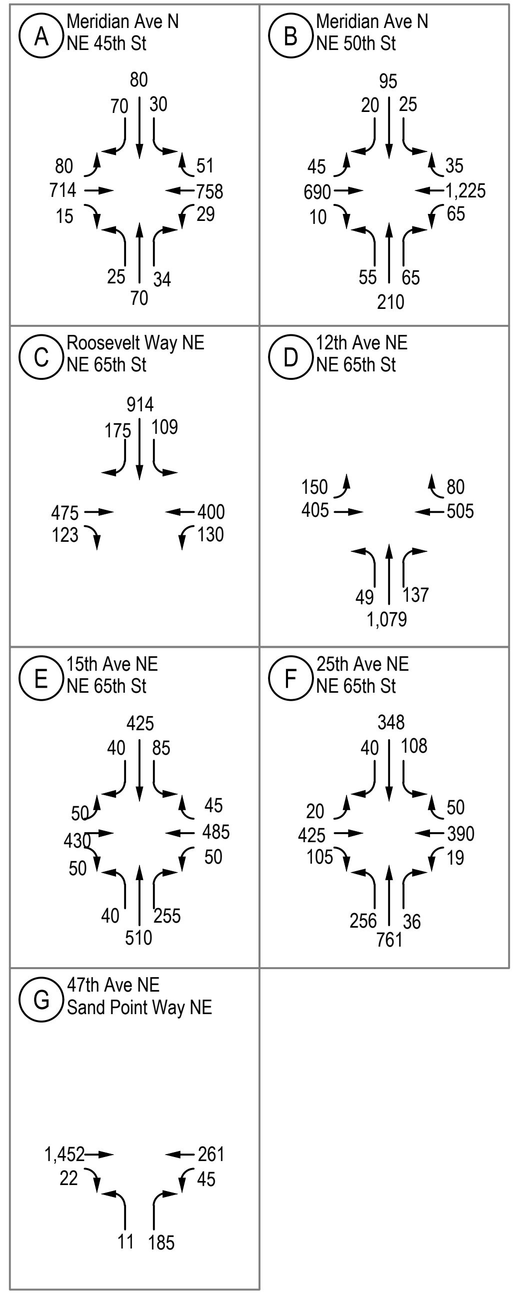
FIGURE
5.6

transpogroup
WHAT TRANSPORTATION CAN BE.

Secondary Impact Zone

Weekday PM peak hour volumes at seven intersections in the secondary impact zone were analyzed by considering future background traffic and volumes associated with the Alternative 1 development. Alternative 1 directional volumes were forecast in the same manner as all primary impact zone study intersections as described above. It was assumed that 5 percent of future volumes would be distributed into the neighborhood roadway network and therefore would not travel through the secondary impact zone study intersections. The resulting secondary impact zone volumes are shown in Figure 5.7.





Alternative 1 Secondary Impact Zone Weekday PM Peak Hour Traffic Volumes

FIGURE
5.7

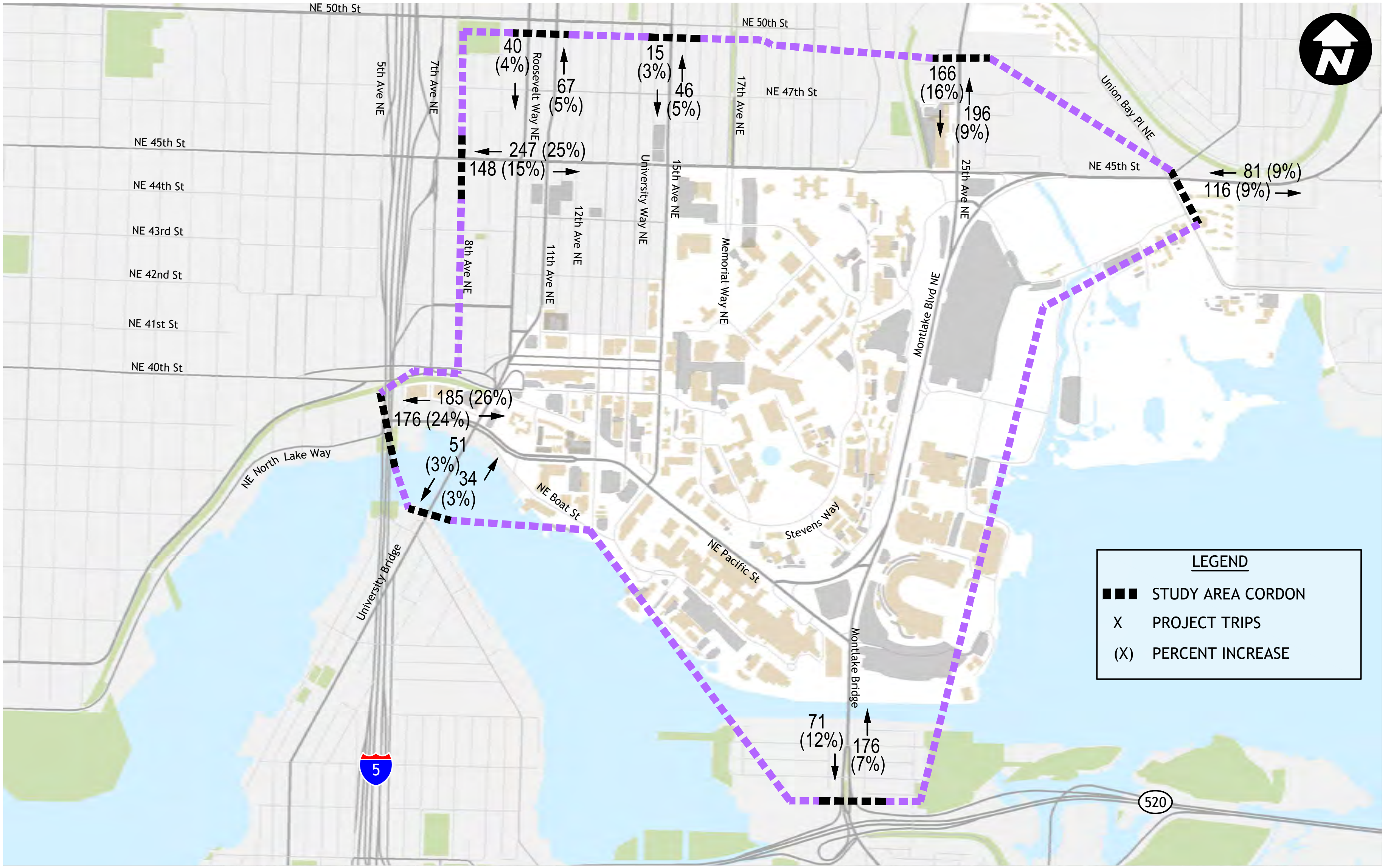
University of Washington 2018 Campus Master Plan

transpogroup
WHAT TRANSPORTATION CAN BE.

5.5.3 Cordon Volume Analysis

Cordon: An imaginary line used to evaluate traffic in and out of the University area and measure the change or increase in traffic associated with the proposed alternatives.

To understand the volumes considered under the different development alternative scenarios, a cordon volume analysis was completed. The cordon volume analysis focused on the major roadways leading to and from the University of Washington and showed the percentage of total trips along the corridor that would be associated with the increased traffic generated by Alternative 1. The cordon volumes and project share associated with Alternative 1 are shown in Figure 5.8. Note that these data reflect the percentage increase associated with continued development on-campus. As shown in the figure, total project-related volumes would be similar to the No Action Alternative even though Alternative 1 would include higher development. This could be due to the limited available capacity on arterials in the area.



Future (2028) Alternative 1 PM Peak Hour Cordon Volumes and Proportional Increase

FIGURE 5.8

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5.5.4 Traffic Operations Performance

Methodology

The methodology used in assessing intersection and corridor LOS is consistent with that described in the Affected Environment (Chapter 3) and No Action Alternative (Chapter 4) scenarios. A detailed description of the methodology used can be found in Appendix B, Methods and Assumptions.

Intersection Operations – Primary Impact Zone

Weekday PM peak hour intersection traffic operations during the Alternative 1 conditions are summarized in Figure 5.9 and Figure 5.10**.** The year 2028 geometry for all of the study-area intersections was assumed to remain the same as No Action Alternative conditions. Additionally, all signal timing splits and offsets were optimized for Alternative 1. Complete intersection LOS summaries are provided in Appendix C.

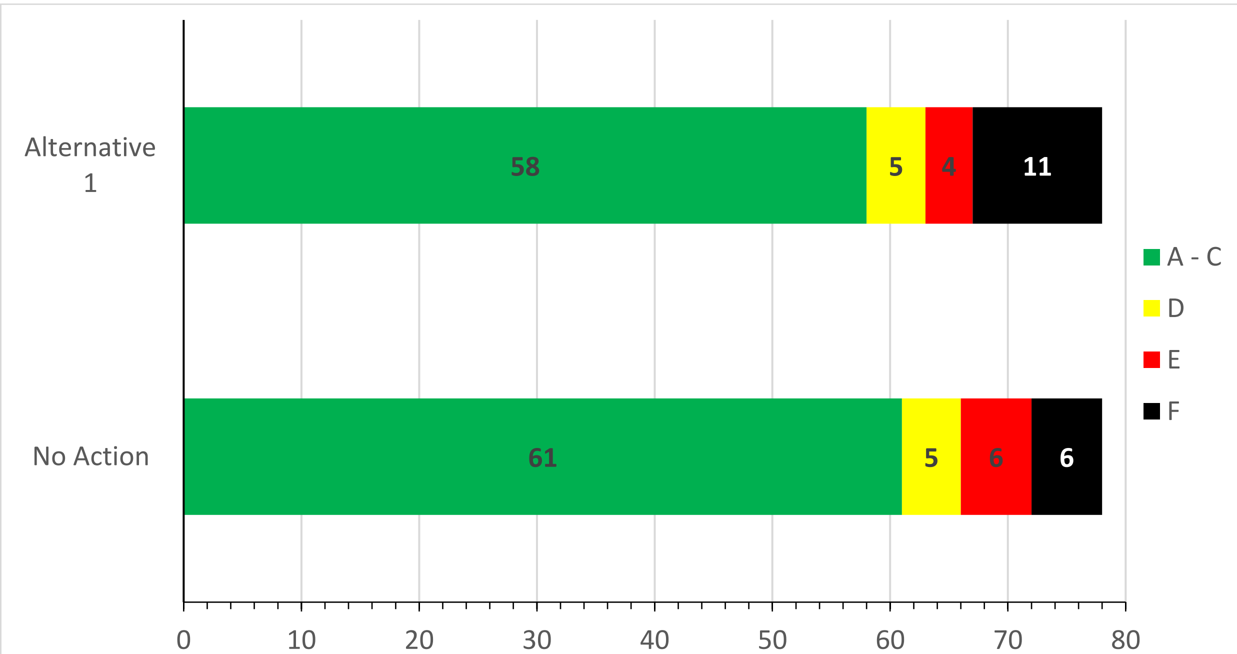


Figure 5.9 Weekday PM Peak Intersection Level of Service Summary

Table 5.15 below illustrates changes in intersection traffic operations at intersections anticipated to operate at LOS E or F during the weekday PM peak hour under future Alternative 1 conditions.

Table 5.15
ALTERNATIVE 1 INTERSECTION LEVEL OF SERVICE SUMMARY

Intersection	No Action		Alternative 1		Change in Delay (sec)	Project Share
	LOS[1]	Delay[2]	LOS[1]	Delay[2]		
16. 9th Ave NE (South) / NE 45th St	E	41	F	67	26	15.9%
29. Montlake Blvd NE / Mary Gates Memorial Dr NE	D	50	E	56	6	5.3%
30. Roosevelt Way NE / NE 43rd St (East)	F	793	F	978	185	3.0%
31. Roosevelt Way NE / NE 43rd St (West)	F	74	F	113	39	3.1%
32. 11th Ave NE / NE 43rd St	E	72	F	110	38	8.1%
46. Roosevelt Way NE / NE 41st St	E	36	E	38	2	1.3%
47. 12th Ave NE / NE 41st St	F	52	F	602	551	24.6%
49. University Way NE / NE 41st St	F	*	F	*	*	28.7%
51. 7th Ave NE / NE 40th St	E	44	F	58	14	5.9%
57. 6th Ave NE / NE 40th St	F	107	F	133	26	5.8%
63. 6th Ave NE / NE Northlake Way	E	38	F	109	71	18.3%
67. 15th Ave NE / NE Pacific St	D	37	E	72	35	20.6%
69. 15th Ave NE / NE Boat St	C	18	F	95	77	31.3%
71. Montlake Blvd NE / Wahkiakum Rd	F	343	F	183	-159	10.9%
72. Montlake Blvd NE / IMA exit	D	34	E	43	9	10.5%

*Volume exceeds capacity and Synchro could not calculate the delay.

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

During the weekday PM peak hour, five additional intersections are anticipated to operate at LOS F with Alternative 1 compared to No Action Alternative conditions. Overall, 20 intersections are anticipated to operate at LOS D or worse during the weekday PM peak hour with Alternative 1, as compared to 17 under No Action conditions. The City of Seattle does not have an LOS standard, but generally considers LOS E and LOS F at signalized intersections and LOS F at unsignalized intersections to reflect poor operations. Intersections that degrade from LOS D to LOS E or operate at LOS E or LOS F under the "with-project" condition, or increase by 5 or more seconds, could be considered significant by the City.

The following intersections are anticipated to degrade to LOS D or worse under Alternative 1 conditions:

16. 9th Avenue NE (South)/NE 45th Street
17. 9th Avenue NE (North)/NE 45th Street
29. Roosevelt Way NE/NE 43rd Street (West)
32. 11th Avenue NE/NE 43rd Street
51. 7th Avenue NE/NE 40th Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
69. 15th Avenue NE/NE Boat Street
72. Montlake Boulevard NE/IMA Exit
73. Montlake Boulevard NE/IMA Entrance

Intersections where the LOS would be E or F and where the Alternative 1 traffic would increase delay by more than 5 seconds are shown in Table 5.16. As shown in the table, most of the intersections are unsignalized. At the two-way stop controlled (TWSC) intersections, the change in delay is represented for the worst movement.

Table 5.16
ALTERNATIVE 1 POTENTIAL INTERSECTION OPERATIONS IMPACTS SUMMARY

Intersection	Traffic Control	Change in Delay (seconds)	Percent of Total (Project Share)
16. 9th Avenue NE (south)/NE 45th Street	TWSC	26	15.9%
29. Montlake Boulevard NE/Mary Gates Memorial Drive NE	Signalized	6	5.3%
30. Roosevelt Way NE/NE 43rd Street (east)	TWSC	185	3.0%
31. Roosevelt Way NE/NE 43rd Street (west)	TWSC	39	3.1%
32. 11th Avenue NE/NE 43rd Street	Signalized	38	8.1%
47. 12th Avenue NE/NE 41st Street	TWSC	551	24.6%
49. University Way NE/NE 41st Street	TWSC	-[1]	28.7%
51. 7th Avenue NE/NE 40th Street	AWSC	14	5.9%
57. 6th Avenue NE/NE 40th Street	AWSC	26	5.8%
63. 6th Avenue NE/NE Northlake Way	AWSC	71	18.3%
67. 15th Avenue NE/NE Pacific Street	Signalized	35	20.6%
69. 15th Avenue NE/NE Boat Street	AWSC	77	31.3%
72. Montlake Boulevard NE/IMA exit	TWSC	9	10.5%

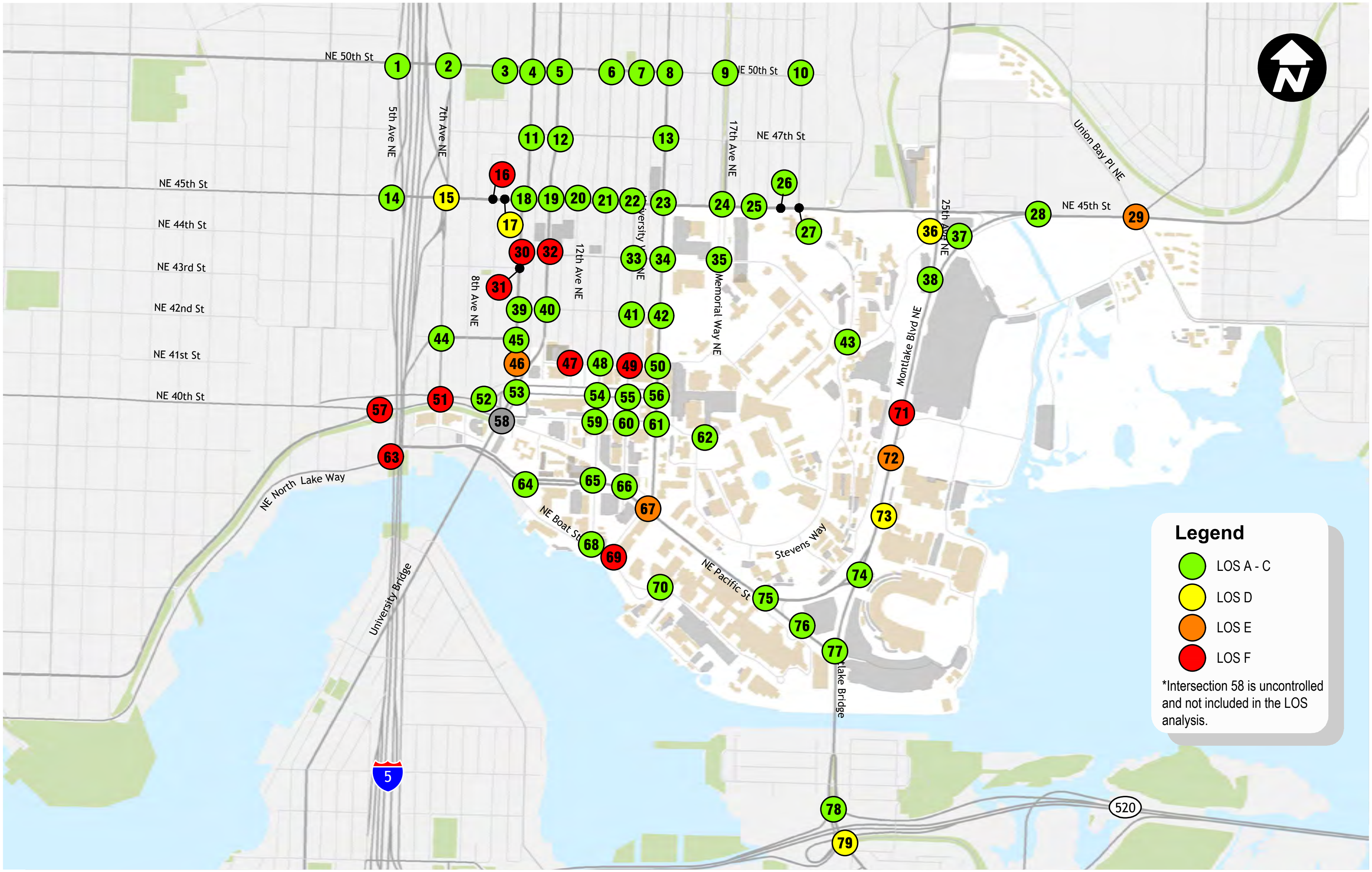
Note: TWSC = two-way stop controlled, AWSC = all-way stop controlled

1. Volume exceeds capacity and Synchro could not calculate the delay.

Of the stop controlled intersections listed in Table 5.16, some of the increased delay could be attributed to higher pedestrian and bicycle volumes. Additionally, the following intersections are located at or near potential garage access locations resulting in a higher share of Alternative 1 project trips:

47. 12th Avenue NE/NE 41st Street
49. University Way NE/NE 41st Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
69. 15th Avenue NE/NE Boat Street
72. Montlake Boulevard NE/IMA exit

Driveways and building access features to be incorporated into planned development can have impacts on the overall trip distribution and individual movements at intersections near these locations. Given the preliminary planning nature of this evaluation, individual traffic impacts should be assessed when final building size and driveway locations are determined. Also, given the grid network, it is anticipated that if drivers experience long delays at unsignalized locations they could alter their trip patterns to reduce delays. It is also recognized that LOS for vehicle traffic, while a consideration, must be increasingly balanced against the assumption that pedestrian, bicycle, and transit travel modes would be encouraged and facilitated. Intersections that are calculated to operate at poor LOS for vehicle traffic are not always considered a high priority for improvement by the City.



Future (2028) Alternative 1 Weekday PM Peak Hour Traffic Operations

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FIGURE **5.10**

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Intersection Operations – Secondary Impact Zone

Weekday PM peak hour intersection traffic operations under the 2028 No Action Alternative and Alternative 1 conditions are shown in Table 5.17. The 2028 geometry for all of the study area intersections were assumed to remain the same as existing conditions. Signal timing splits were optimized under 2028 Alternative 1 conditions. Complete intersection LOS summaries are provided in Appendix C.

Table 5.17
INTERSECTION LEVEL OF SERVICE SUMMARY – SECONDARY IMPACT ZONE

Intersection	No Action		Alternative 1		Change in Delay (sec)
	LOS[1]	Delay[2]	LOS[1]	Delay[2]	
A. Meridian Avenue N/N 45th Street	B	12	B	13	1
B. Meridian Avenue N/N 50th Street	B	17	B	17	0
C. Roosevelt Way NE/NE 65th Street	E	73	E	79	6
D. 12th Avenue NE/NE 65th Street	C	23	C	23	0
E. 15th Avenue NE/NE 65th Street	F	161	F	160	-1
F. 25th Avenue NE/NE 65th Street	E	80	F	132	52
G. 47th Avenue NE/Sand Point Way NE	D	30	F	59	29

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

As shown in Table 5.17 the secondary impact zone intersections are anticipated to operate at the same LOS under Alternative 1 as they do under the No Action Alternative conditions with the exception of the 25th Avenue NE/ NE 65th Street and 47th Avenue NE/ Sand Point Way NE intersections. The 25th Avenue NE/ NE 65th Street intersection is anticipated to degrade from LOS E to LOS F with approximately a 52 second increase in delay. The 47th Avenue NE/ Sand Point Way NE intersection is anticipated to degrade from LOS D to LOS F with approximately a 29 second increase in delay. Additionally, the 15th Avenue NE/NE 65th Street intersection is anticipated to experience a slight decrease in delay.

5.5.5 Arterial Operations

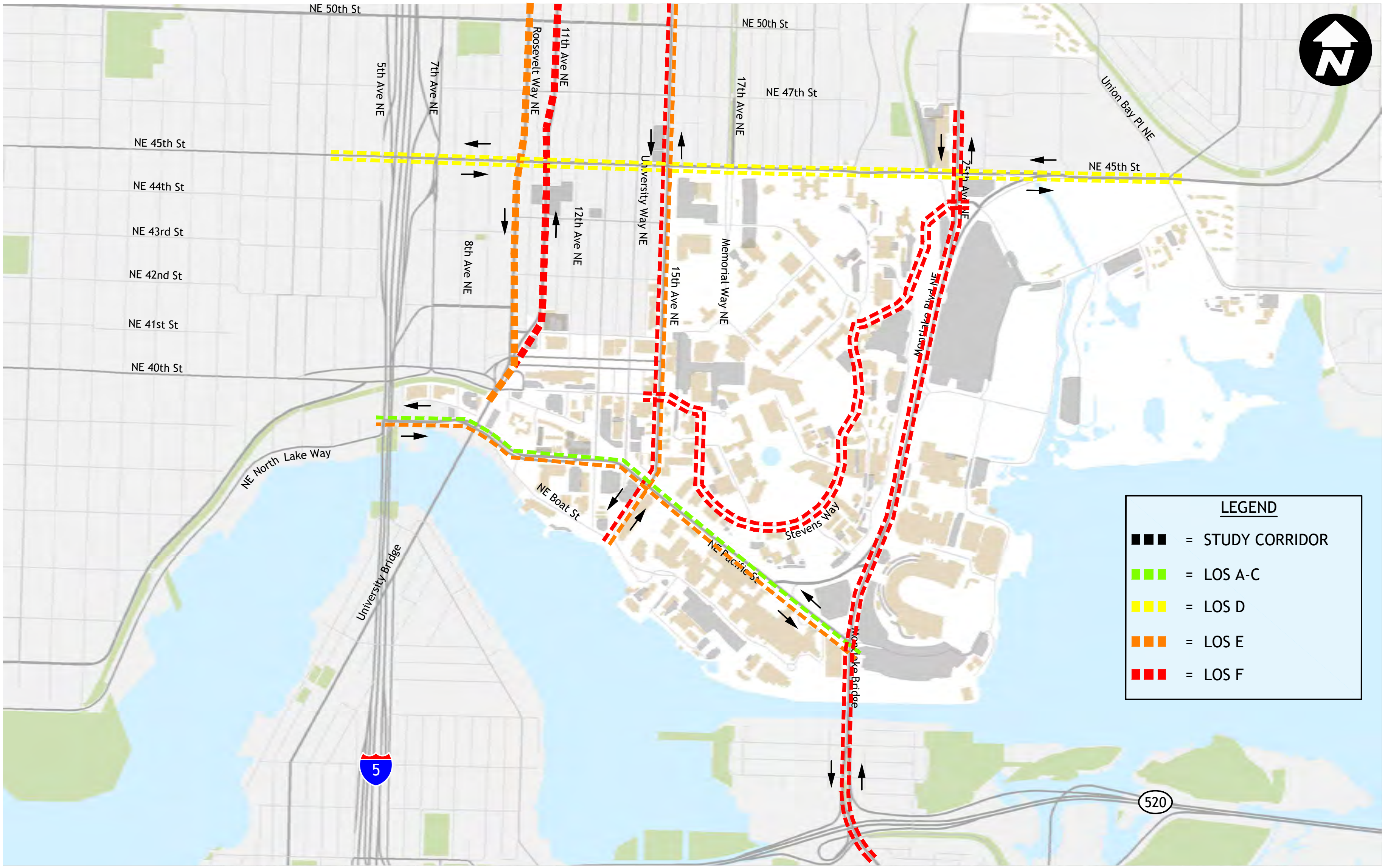
Arterial travel times and speeds were evaluated along NE 45th Street, Pacific Street, 11th Avenue NE, Roosevelt Way NE, 15th Avenue NE, Montlake Boulevard NE, and Stevens Way NE, along with traffic data associated with Alternative 1. These data are consistent with the previously described methodology for both existing and future No Action Alternative conditions. This includes the application of the adjustment factors previously described. Table 5.18 and Figure 5.11 summarize weekday PM peak hour arterial travel times and speeds. Detailed corridor operations worksheets are provided in Appendix C.

Table 5.18
WEEKDAY PM PEAK HOUR ARTERIAL OPERATIONS SUMMARY

Corridor	No Action Alternative		Alternative 1	
	LOS[1]	Speed[2]	LOS[1]	Speed[2]
11th Avenue NE between NE Campus Parkway and NE 50th Street				
Northbound	F	5.0	F	3.9
15th Avenue NE between NE Boat Street and NE 50th Street				
Northbound	E	8.0	E	7.2
Southbound	D	9.2	F	7.0
Montlake Boulevard NE between E Lake Washington Boulevard and NE 45th Street				
Northbound	E	11.5	F	9.9
Southbound	F	8.5	F	8.5
NE 45th Street between 5th Avenue NE and Union Bay Place NE				
Eastbound	D	12.0	D	12.0
Westbound	D	11.6	D	10.6
NE Pacific Street (NE Northlake Way) between 6th Avenue NE and Montlake Boulevard E				
Eastbound	C	18.3	E	11.6
Westbound	C	21.9	C	20.7
Roosevelt Way NE between NE Campus Parkway and NE 50th Street				
Southbound	D	10.4	E	8.8
Stevens Way NE between 15th Avenue NE and 25th Avenue NE				
Eastbound	F	3.6	F	3.5
Westbound	F	3.1	F	2.3

1. Level of service.
2. Average speed in miles per hour.

As shown in Table 5.18, with Alternative 1, the arterials would experience increases in delay and slower travel speeds. Anticipated LOS is as follows: Southbound 15th Avenue NE (from LOS D to LOS F), northbound Montlake Boulevard NE (from LOS E to LOS F), eastbound NE Pacific Street (from LOS C to LOS E), and southbound Roosevelt Way NE (from LOS D to LOS E).



Future (2028) Alternative 1 Weekday PM Peak Hour Corridor Traffic Operations

FIGURE 5.11

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5.5.6 Screenline Analysis: Primary Impact Zone

Screenline: An imaginary line across which the number of passing vehicles is counted.

This section describes the analysis completed for two designated screenlines within the study area, consistent with City of Seattle Transportation Concurrency system. Screenlines are imaginary lines across which the number of passing vehicles is counted. In this study, screenlines were selected to count vehicle traffic entering and exiting the University of Washington primary and secondary impact zones. As part of the Mayor's Seattle 2035 Comprehensive Plan (City of Seattle, 2016), two screenlines were identified within the vicinity of the University of Washington, as shown in Figure 5.12. Screenline 5.16 is an east-west screenline, measuring north-south travel, and extends along the ship canal to include the University and Montlake bridges. Screenline 13.13 is a north-south screenline, measuring east-west travel, and extends east of Interstate 5 (I-5) between NE Pacific Street and NE Ravenna Boulevard.

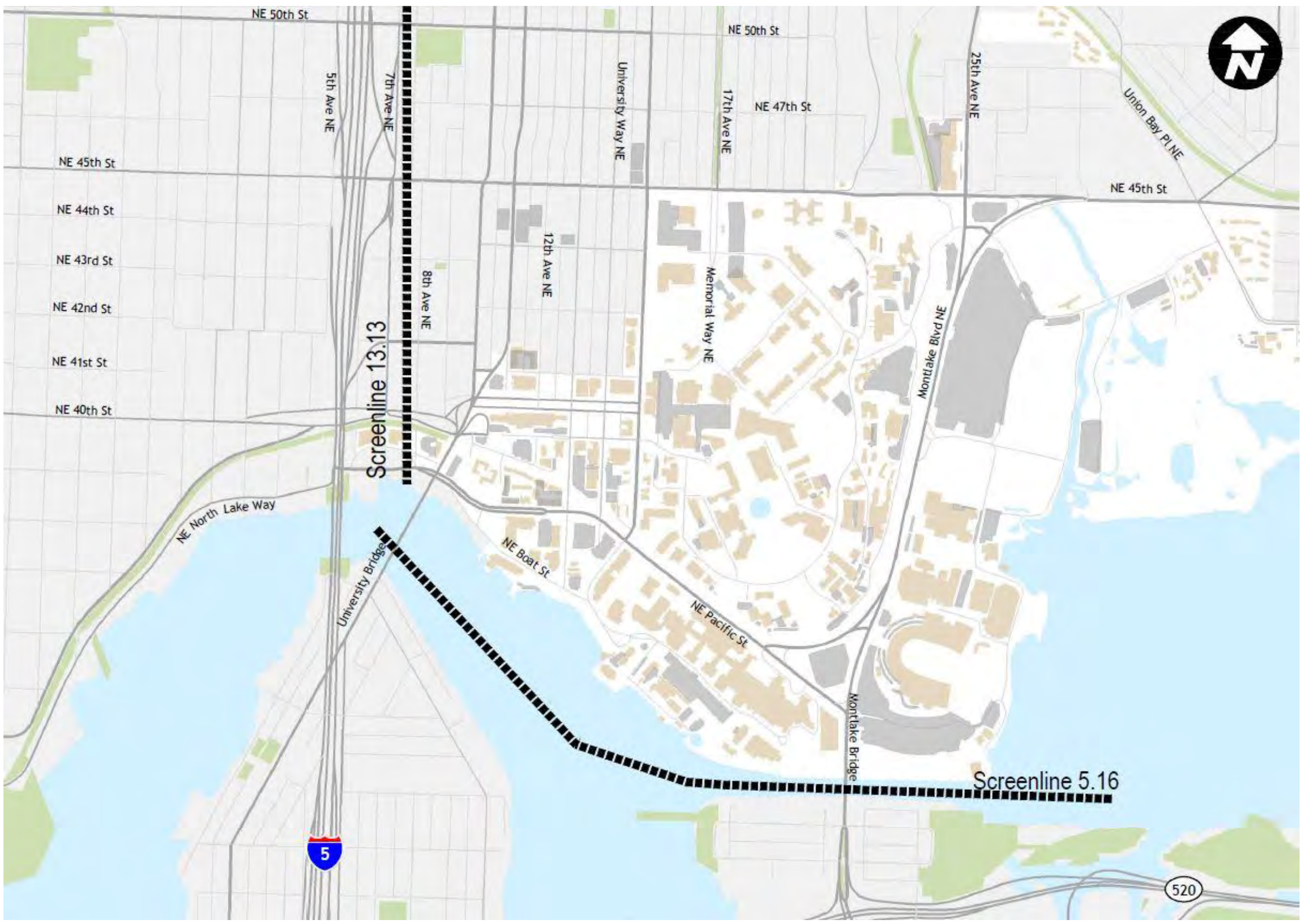


Figure 5.12 Study Area Screenlines

The analysis included volume-to-capacity (V/C) calculations for the vehicles traversing the screenlines using Alternative 1 traffic volumes and interpolated roadway capacity estimates. Roadway capacity for the 2028 horizon year was interpolated using 2016 capacity estimates described in Chapter 3, Affected Environment, and 2035 capacity estimates referenced in the May 2016 Seattle Comprehensive Plan Update Final EIS. Alternative 1 roadway capacity estimates are shown in Table 5.19 below. Detailed screenline volumes and V/C calculations are included in Appendix C.

Table 5.19
ROADWAY CAPACITY AT STUDY AREA SCREENLINES

Screenline	Alternative 1 Capacity
5.16 – Ship Canal, University, and Montlake Bridges	
Northbound	4,210
Southbound	4,210
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard	
Eastbound	6,119
Westbound	6,119

Source: Transpo Group, 2016

LOS standards for the screenline analysis were based on the V/C ratio of a screenline. As described in the Seattle Comprehensive Plan Update EIS, the LOS standard V/C ratios for Screenline 5.16 and Screenline 13.13 were 1.20 and 1.00, respectively. For this study, screenline V/C ratios that did not exceed the LOS standard were considered acceptable. A summary of the Alternative 1 screenline analysis is shown in Table 5.20. Detailed screenline analysis calculations are included in Appendix C.

Table 5.20
SCREENLINE ANALYSIS SUMMARY

Screenline	Screenline Volume	Capacity	V/C	LOS Standard V/C
5.16 – Ship Canal, University, and Montlake Bridges				
Northbound	4,045	4,210	0.96	1.20
Southbound	4,522	4,210	1.07	1.20
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard				
Eastbound	3,645	6,119	0.60	1.00
Westbound	3,916	6,119	0.64	1.00

Source: NACTO, Seattle Comprehensive Plan Update EIS, and Transpo Group, 2016

As shown in Table 5.20, all Alternative 1 screenline V/C ratios would meet the acceptable LOS standard.

5.5.7 Service/Freight Routes

Consistent with existing conditions, freight and delivery access would be provided for each building. The deliveries would largely come directly from the shippers, though a proportion of these may come through the University's interdepartmental delivery system. Because the specific development sites or freight/service needs are not yet known, an analysis at a site-specific level would not be appropriate at this time. The Seattle Municipal Code outlines the desired locations and number of loading berths and zones required for a project. This information would be used as guidance during the permitting of any future site. In general, an increase in delivery/service-related traffic would occur in the areas being developed. Therefore, no significant impact due to added freight traffic associated with Alternative 1 was identified.

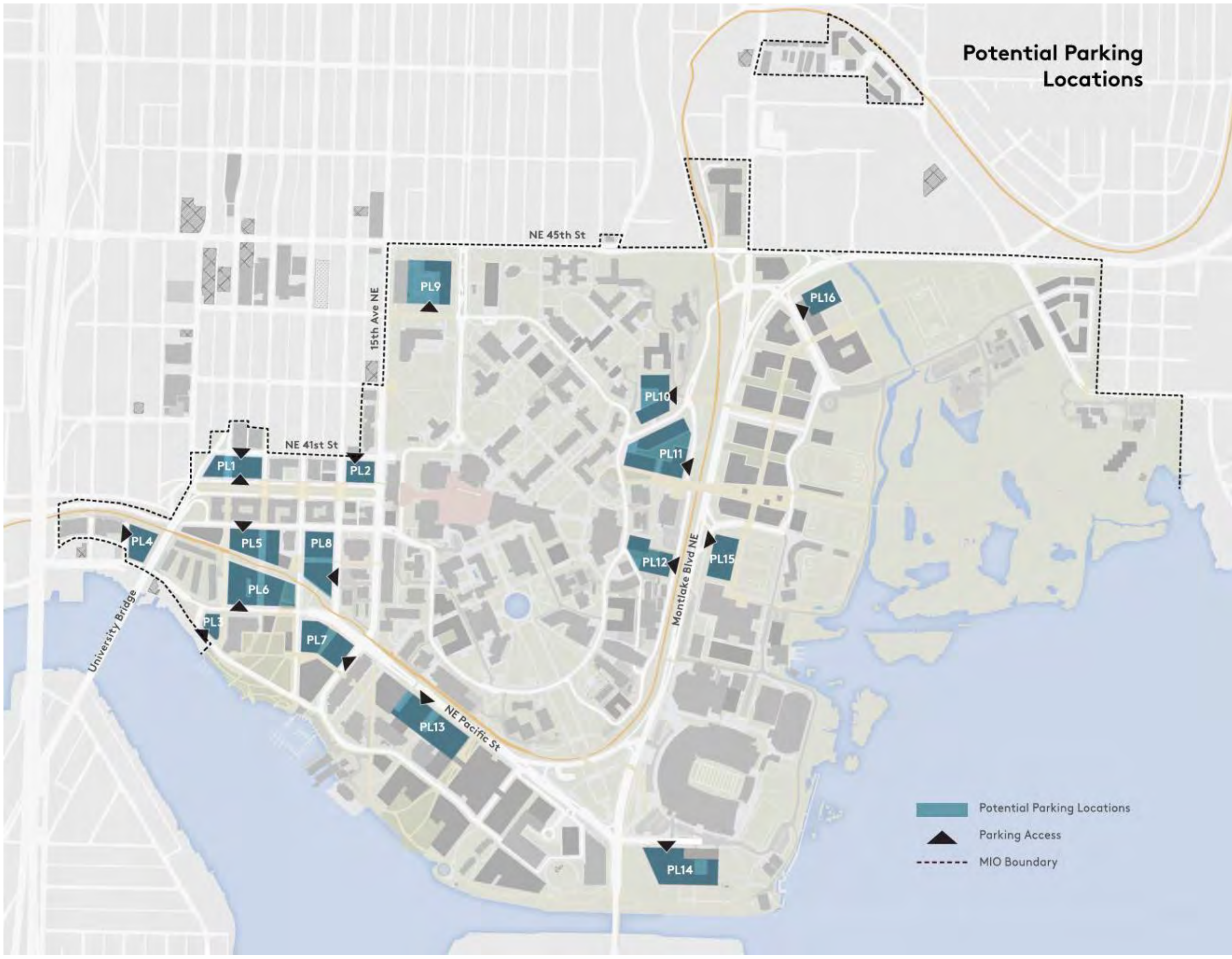
5.5.8 Parking

Parking Supply

Parking impacts were determined by evaluating each of the Development Alternatives assuming that the parking supply would be increased or decreased within each sector to achieve an 85-percent utilization without exceeding the parking cap. An 85- to 90-percent utilization reflects a level at which drivers are typically able to find parking without difficulty and circulation through the parking areas while searching for parking is minimized. With Alternative 1, the parking supply cap would be 10,250 spaces for all sectors combined.

Additional parking would be constructed on one or more of the identified parking sites reflected in Figure 5.13 below. Any increases in parking supply would be phased such that the existing City-University Agreement (CUA) parking cap would be maintained. Strategies to maintain the parking cap could include:

- Factoring in the parking demand and the implications on the parking cap when determining phasing of development
- Removing parking in sectors that are underutilized so that parking can be constructed in more desirable locations consistent with parking demand projections
- Shifting modes to reduce the overall parking needs for the campus to minimize the amount of new parking needed



Source: Sasaki Architects, July 2017 CMP

Figure 5.13 Potential Sites for Campus Parking

Parking Demand

Alternative 1 would develop 6 million gsf on-campus. Table 5.21 provides a comparison of the resulting peak parking demand by population between the No Action Alternative and Alternative 1. The evaluation assumes that, with the changes in campus parking supply, potential on-street parking demand would occur within the campus.

Table 5.21
PEAK PARKING DEMAND ON-CAMPUS / ON-STREET

	Vehicles Parked							
	Students[1]		Faculty[1]		Staff[1]		Total	
	No Action[2]	Alt 1[3]	No Action[2]	Alt 1[3,4]	No Action[2]	Alt 1[3]	No Action[2]	Alt 1[3]
On-Campus	1,857	2,298	1,096	1,358	3,814	4,768	6,768	8,424
Potential On-Street	134	136	49	50	94	96	277	282
Total	1,991	2,435	1,146	1,408	3,908	4,863	7,045	8,706

Source: Transpo Group, 2016

1. Demand by population assumes a SOV at 20 percent for the campus.
2. No Action forecasts are based on projected increases in population.
3. Approximately 3 percent of the total parking demand is anticipated to be generated by the proposed partner development (500,000 gsf in West Campus).

As shown in the table, compared to the No Action Alternative, Alternative 1 would add a parking demand of approximately 1,660 vehicles, assuming a 20-percent SOV for the campus. For the campus as a whole, the Alternative 1 parking demand would continue to be accommodated within the existing parking supply and would not impact the CUA parking cap.

Similar to the No Action Alternative, Alternative 1 on-campus parking demand and utilization were reviewed by sector to provide context (see Table 5.22 below). Allocation of Alternative 1 parking demand by sector was based on projected development as documented in Appendix B: Methods and Assumptions. This evaluation assumed that on-street parking would be allocated to on-campus facilities, given the increases and reallocation of parking supply to achieve an 85-percent utilization.

Table 5.22
PEAK PARKING DEMAND BY SECTOR

Sector	Parking Supply Cap	Parking Demand			% Utilization
		No Action[1]	Alternative 1		
			Growth[2]	Total	
West	2,820	1,428	969	2,397	85%
South	1,910	1,187	436	1,623	85%
Central	3,510	2,689	291	2,980	85%
East	2,010	1,464	242	1,706	85%
Total	10,250	6,768	1,938	8,706	85%

Source: Transpo Group, 2016

1. On-campus parking demand for the No Action Alternative is based on the projected increase in population. The analysis does not include on-street parking demand increases noted in the previous table since these would not be parking within the sectors.
2. Growth in parking demand for Alternative 1 is based on the projected increase in population.

As Table 5.22 reflects, reallocation of parking would result in a parking supply under the existing cap and an 85-percent utilization by campus sector and for the campus as a whole. The additional parking and reallocation of parking supply would provide a better relationship between localized supply and demand and thus reduce the likelihood of parking beyond University of Washington facilities (i.e., within the neighborhoods).

Secondary Parking Impacts

Parking outside the primary impact zone would likely continue with Alternative 1 similar to the No Action Alternative. This could include people parking their vehicles in unrestricted spaces within areas served by transit and then using transit to travel to campus. With future campus growth, this could occur at higher levels compared to the No Action Alternative.

5.6 AERIAL/STREET VACATIONS

The City of Seattle has established policies related to the review and consideration of alley and street vacations. The City's Street Vacation Policies (Clerk File 310078) are intended to guide City Council decisions regarding the vacation of public rights-of-way. Policy 1, which is related to Circulation and Access, states:

"Vacations may be approved only if they do not result in negative effects on both the current and future needs for the City's vehicular, bicycle, or pedestrian circulation systems or an access to private property, unless the negative effects can be mitigated."

Alternative 1 proposes a street vacation along NE Northlake Place east of 8th Avenue NE. Potential impacts would be concentrated within the immediate vicinity of NE Northlake Place with no impacts anticipated outside this area. Potential pedestrian, bicycle, transit, and vehicle impacts for each of the street vacations under Alternative 1 are outlined below.

NE Northlake Place

- **Pedestrians and Bicycles.** The vacation of Northlake Place would allow for a larger parcel to accommodate a new building. Pedestrian and bicycle use of this street is currently limited and generally associated with uses that have access along Northlake Place. With the vacation, these uses would be redeveloped. Pedestrian and bicycle facilities would be developed in the vicinity of the new building including the proposed green south of the Northlake Place parcels.
- **Transit.** No buses currently use Northlake Place. Primary bus service is located along NE Pacific Street, north of Boat Street NE. Given the relatively low traffic volumes of Northlake Place (approximately 30 vehicles during the weekday AM and PM peak hours), it is not anticipated that shifts in traffic would have a noticeable impact on transit.
- **Vehicle.** The section of NE Northlake Place proposed for street vacation accommodates two-way east/westbound lanes and one travel lane in each direction. NE Northlake Place dead ends approximately 170 feet east of 8th Avenue NE. The street is classified as an access street by the City of Seattle.
    - **Traffic Volumes –** Traffic volumes are relatively low along Northlake Place with approximately 30 vehicles during both the AM and PM peak hours.
    - **Traffic Operations –** No operational impacts are anticipated as a result of shifts in traffic volumes with the vacation.
    - **Service/Freight Routes –** No impacts are anticipated to service and freight routes as a result of the vacation.
    - **Parking –** Approximately 10 to 15 stalls would be displaced with the vacation. The Alternative 1 parking analysis shows that there would be sufficient campus parking to accommodate this displacement.

Further analysis would be provided to the City consistent with the policy requirements at such time an application for a street vacation is made. The EIS alternatives and supporting analysis reflect the vacation as proposed.

5.7 VEHICLE TRIP CAPS

Vehicle Trip Caps. Table 5.23 summarizes the potential vehicle trip cap compliance assuming an SOV rate of 20 percent. Historic SOV mode splits are between 18 and 20 percent (2014–2015) and 17 percent at 2016. Recent opening of the University of Washington Station (Link light rail) and anticipated expansion to a U District Station in 2021 suggests that the 20-percent projection for SOV modes used in this analysis is conservative and could be lower. As shown in the table, the vehicle trip cap is forecast to be maintained; however, the percentage of vehicle trips under the cap would decline with forecast growth levels. This suggests that the University of Washington would need to find ways through the Transportation Management Plan (TMP) demand management strategies to further reduce the amount of SOVs that are generated during the critical peak periods subject to the trip caps. The 2018 Seattle CMP goal is 15% SOV by 2028.

Table 5.23
VEHICLE TRIP CAP SUMMARY

Location/Peak Period	Trip Cap (vehicles/ hour)	Alternative 1
University of Washington Campus		
AM Peak Period Inbound (7–9 am)	**7,900**	**8,230**
PM Peak Period Outbound (3–6 pm)	8,500	8,230
U District		
AM Peak Period Inbound (7–9 am)	**10,100**	**10,275**
PM Peak Period Outbound (3–6 pm)	10,500	10,275

As described in Chapter 3, Affected Environment, projected trip cap outcomes are forecasts. Changes or shifts in travel behavior that would result in lower drive alone modes would reduce these estimates of AM entering trips. The University will continue monitoring as part of the TMP. Reductions in proportions of students, faculty, and staff driving alone, even by 1 percent, would result in the AM inbound traffic volumes adhering to the cap. The analysis assumes no change in mode split from 2015 levels (i.e. 20 percent), and thus may be considered conservative given that the current 2016 mode split is 17 percent, and worst-case assumptions given the planned light rail expansions from the University of Washington to Northgate by 2021 and Lynnwood by 2023. When completed, these rail expansions will greatly enhance access for students, faculty, and staff to reach the University by convenient transit and could reduce the overall proportion of drive alone travel to the campus. While this approach is conservative and does not factor in the potential benefits of increased future light rail access, the University would continue to maintain compliance with the trip caps as part of their overall management effort, consistent with the institution's history, and implemented through the TMP, assuming the more conservative 20 percent mode split would result in exceeding the U District cap in about 2025. A sensitivity with lower drive alone mode split is included in Appendix B. As noted previously, growing trends in transit use for campus populations indicate this 20 percent drive alone mode split may be conservative. As the University commits to a lower mode split percentage, these caps would not be exceeded.

Transportation Management Plan (TMP): A transportation management plan provides strategies for limiting traffic impacts and promoting active communities by managing vehicle trips and parking, as well as accommodating transit and non-motorized travel modes.

Parking Caps. Depending on the amount of new parking constructed to replace displaced facilities and to provide additional parking more proximate to new campus buildings, the on-campus parking supply will be managed to assure maintenance of the 12,300 total parking supply cap. This could require temporary or permanent elimination of some parking spaces, or repurposing the spaces during weekday conditions while maintaining their availability for use during major sporting events at Husky Stadium.

FINAL

6 IMPACTS OF ALTERNATIVE 2

This chapter evaluates all modes of travel and compares **Alternative 2** to the No Action Alternative. Alternative 2 would encompass operations in the horizon year of 2028 with approximately 6 million gross square footage of new development. The focus of those improvements would be primarily in the West and South campus sectors with more limited development in the Central and East campus sectors.

This chapter summarizes the results of the analysis conducted for Alternative 2: CMP Proposed Allocation with Existing Height Limits. As in the previous chapters, this evaluation examines the impacts to the key transportation elements and transportation modes.

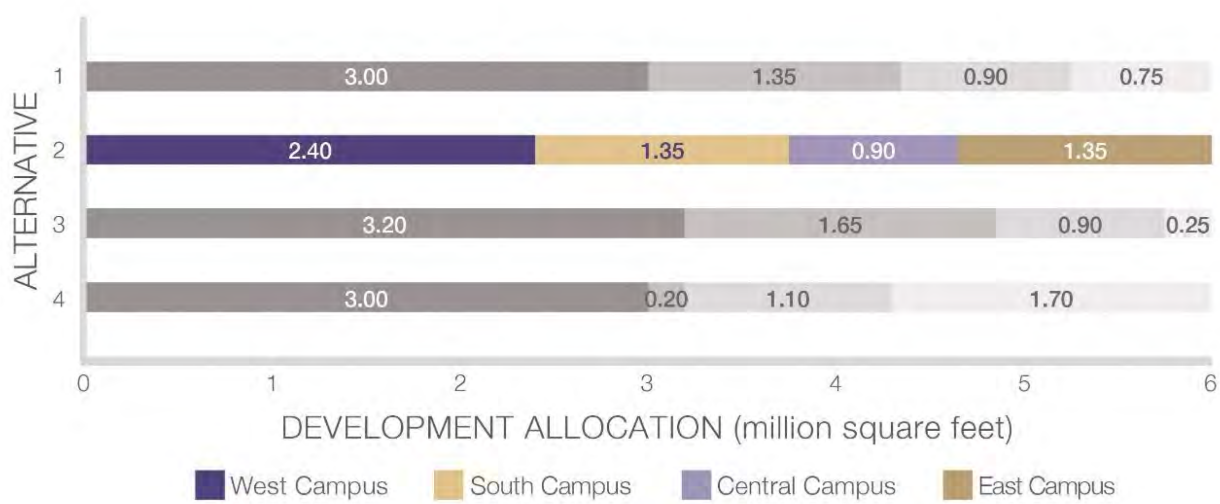
The No Action Alternative, used to compare existing conditions to Alternative 2, assumes a proportion of the development to be 211,000 gross square footage (gsf), as outlined in the City of Seattle adopted 2035 Comprehensive Plan and the adopted U District Rezone.

6.1 CHANGING CAMPUS CHARACTERISTICS

6.1.1 Description of the Alternative

This section summarizes the evaluation of Alternative 2 with respect to the transportation elements identified in Chapter 3, Affected Environment. The proposed University of Washington development in Alternative 2 is anticipated to be primarily located in the West and East campus sectors. The technical analysis of Alternative 2 focused on the weekday PM peak period.

Alternative 2 would include the development of 6 million net new gsf throughout the campus. Of this total area, approximately 2.4 million gsf would be located in West Campus, 1.35 million gsf in South Campus, 900,000 gsf in Central Campus, and 1.35 million in East Campus, as shown in Figure 6.1.



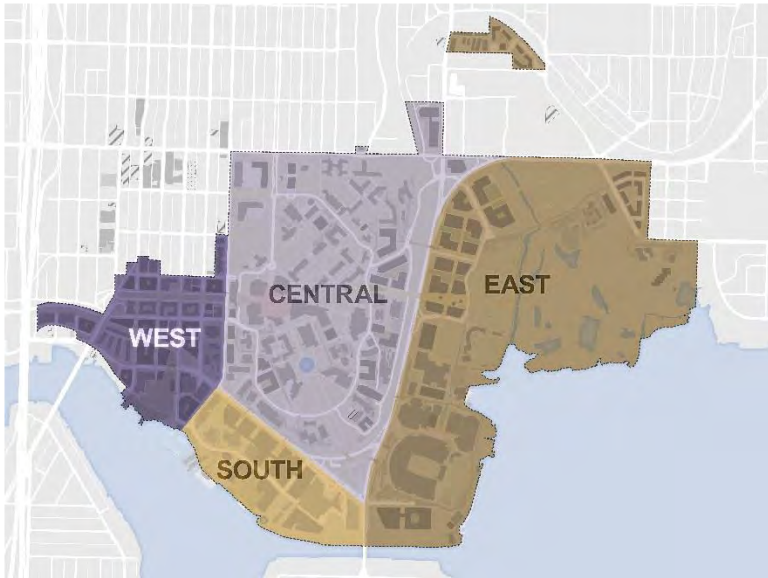


Figure 6.1 Alternative 2 Development Allocation

6.1.2 Trip Generation by Mode

This section provides a summary of the anticipated trip generation for pedestrian, bicycle, transit, and vehicle modes to campus. The trip generation methodology used for assessing the increase in trips under Alternative 2 is consistent with that previously described in Chapter 4, No Action Alternative.

6.2 PEDESTRIANS

6.2.1 Performance Measures

The following pedestrian-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development within 1/4 Mile of Multi-Family Housing
- Proportion of Development within 1/4 Mile of University of Washington Residence Halls
- Quality of Pedestrian Environment
- Pedestrian Screenline Demand and Capacity
- Pedestrian Transit Station/Stop Area LOS

These measures reflect the effectiveness of the pedestrian network in providing safe and easy access to pedestrian destinations, specifically housing, thereby maintaining a high walk mode choice on campus. A comparisons between Alternative 2 relative to the No Action Alternative and Alternative 1 is provided for each measure below.

Proportion of Development within 1/4 Mile of Multifamily Housing

Walking makes up nearly 30 percent of all existing trips to and from campus. Proximity of campus development to housing is therefore one important measure to assessing the propensity of people to walk. This measure assesses the proximity of the current campus buildings and development to nearby multifamily housing. As shown in Table 6.1, 67 percent of Alternative 2 development would be within a 1/4-mile proximity to multifamily housing.

Table 6.1
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF MULTIFAMILY HOUSING

Sector	No Action Gross square feet (gsf)	Alternative 1 Gross square feet (gsf)	Alternative 2 Gross square feet (gsf)
West	211,000	3,000,000	3,000,000
South	NA	0	0
Central	NA	589,985	723,460
East	NA	0	897,964
Total	**211,000**	**3,589,985**	**4,021,424**
Percent	***100%***	***60%***	***67%***

Proportion of Development within 1/4 Mile of University of Washington Residence Halls

This performance measure assesses the proximity of campus development within walking distance of residence halls. For this analysis, University of Washington residence halls were identified and then buffered by a 1/4 mile. As shown in Table 6.2, 79 percent of the new development in Alternative 2 would be within a 1/4-mile proximity to residence halls.

Table 6.2
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RESIDENCE HALLS

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)
West	211,000	3,000,000	3,000,000
South	NA	249,344	249,344
Central	NA	798,357	723,460
East	NA	750,000	1,350,000
Total	**211,000**	**4,797,701**	**4,722,804**
Percent	***100%***	***80%***	***79%***

Quality of Pedestrian Environment (Primary and Secondary Impact Zones)

Alternative 2 would provide several enhancements to pedestrian travel within the Major Institution Overlay (MIO) where development would occur. Improvements in West Campus would primarily include improvements to sidewalks and a new Americans with Disabilities Act (ADA) accessible pedestrian connection between West and Central Campus. Pedestrian demand in and around West Campus would increase with added uses.

The new pedestrian connections in South Campus, would improve access to Portage Bay; however, improved access and connectivity could be less than Alternative 1. South Campus would see an increase in pedestrian travel, although not on the same scale as West or East Campus.

In addition to these upgrades, the City of Seattle's Pedestrian Master Plan highlights new Neighborhood Greenways within the primary and secondary impact zones.

Within the primary impact zone, several greenways are planned in the following locations:

- A southern extension of the existing 12th Avenue NE Neighborhood Greenway
- Walla Walla Road
- NE Boat Street from NE Pacific Street to 15th Avenue NE, which would improve pedestrian connectivity from the Cheshiahud Lake Union Loop to the University of Washington campus
- 20th Avenue NE north of 45th Street and NE 47th Street west of 20th Ave NE, which would increase pedestrian connectivity to the secondary impact zone, and would connect to other planned greenways including 11th Avenue NE, NE 55th Street, and NE 62nd Street
- NE Clark Road

Within the secondary impact zone, greenways in the east section are planned in the following locations:

- 5th Avenue NE
- NE 46th Street
- Keystone Place N

And in the west section:

- NE Surber Drive
- NE 50th Street

Pedestrian Screenline Demand and Capacity

The pedestrian screenline capacity analysis evaluates the peak hour demand, capacity, and level of service (LOS) at all at-grade and above-grade crossing locations along Montlake Boulevard NE, NE Pacific Street, 15th Avenue NE, and NE 45th Street. The following section summarizes pedestrian screenline volumes in Alternative 2.

Pedestrian Growth from Transit Ridership

Pedestrian growth from increased transit ridership was added to transit stop pedestrian volumes aggregated by screenline, similar to Alternative 1 as described in Chapter 5. This growth accounts for all new pedestrians in the University of Washington study area that would be generated by additional net new transit trips to and from campus.

Pedestrian Growth from Alternative 2 Development

Pedestrian growth anticipated with Alternative 2 was assumed to be relative to the No Action Alternative, and evaluated using the same analysis process as Alternative 1 (see Chapter 5). Table 6.3 summarizes Alternative 2 peak hour pedestrian screenline volumes and LOS.

Table 6.3
PEAK HOUR PEDESTRIAN VOLUME AND LEVEL OF SERVICE

Screenline	No Action Alternative		Alternative 2	
	Peak Hour Pedestrian Volume (People/hour)	Level of Service (LOS)	Peak Hour Pedestrian Volume (People/hour)	Level of Service (LOS)
Montlake Boulevard NE	14,770	A	17,948	A
NE Pacific Street	3,744	A	4,780	A
15th Avenue NE	12,078	A	15,744	A
NE 45th Street	2,272	A	2,614	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

As shown in Table 6.3, Alternative 2 peak hour aggregate pedestrian volumes for all screenlines would be at LOS A.

Pedestrian Transit Station/Stop Area LOS

This measure evaluates the peak hour demand, capacity, and LOS at key transit stops along Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE. The following sections summarize the pedestrian space per person and LOS at these locations with Alternative 2 development.

Pedestrian Growth from Transit Ridership

Additional growth due to increased transit ridership was added to transit stop pedestrian volumes aggregated by campus sector, similar to Alternative 1 as described in Chapter 5. This growth accounts for all new pedestrians in the University of Washington study area that would be generated by additional net new transit trips to and from campus.

Pedestrian Space from Alternative 2 Development

Pedestrian space anticipated with Alternative 2 was assumed to be relative to the No Action Alternative and evaluated using the same method as Alternative 1 (see Chapter 5). Table 6.4 summarizes Alternative 2 peak hour pedestrian space and LOS.

Table 6.4
PEAK HOUR PEDESTRIAN SPACE AND LEVEL OF SERVICE

Stop Location	Stop ID Number	No Action Alternative		Alternative 2	
		Pedestrian Space (ft^2/person)	Level of Service (LOS)	Pedestrian Space (ft^2/person)	Level of Service (LOS)
NE Pacific Street Bay 1	1	45.0	A	10.9	B
NE Pacific Street Bay 2	2	39.0	A	10.4	B
NE Pacific Street at 15th Avenue NE	3	7.5	C	1.7	F
15th Avenue NE at Campus Parkway	4	62.4	A	8.5	C
15th Avenue NE at NE 42nd Street	5	50.5	A	6.6	D
15th Avenue NE at NE 43rd Street	6	27.8	A	7.1	C
Montlake Boulevard Bay 4	7	39.0	A	23.3	A
Montlake Boulevard Bay 3	8	108.7	A	64.9	A
Stevens Way at Pend Oreille Road	9	19.0	A	12.2	B
Stevens Way at Benton Lane	10	36.4	A	22.3	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

As shown in Table 6.4, Alternative 2 peak hour pedestrian space for all transit stops, with the exception of locations 3 and 5, would be at LOS C or better. Location 3 (mid-block near the 15th Avenue NE/ NE Pacific Street intersection) and location 5 (at the 15th Avenue NE/ NE 42nd Street intersection) would be at LOS F and LOS D, respectively.

6.3 BICYCLES

6.3.1 Performance Measures

The following bicycle-related performance measures have been identified to assess and compare alternatives:

- Burke-Gilman Trail Capacity
- Bicycle Parking and Utilization
- Quality of Bicycle Environment

Burke-Gilman Trail Capacity

The Burke-Gilman Trail is anticipated to experience increased demand in the West, South, and East campus sectors, similar to Alternative 1. However, the balance of this growth would be oriented toward East Campus and less toward West Campus compared to Alternative 1. The development in West Campus with Alternative 2 could result in trail facility improvements, like those in the Mercer Court area. Increased cross traffic and travel along the trail segment is anticipated in all areas of campus particularly in East Campus with large redevelopment of E1 from parking to buildings. Planned expansion of the Burke-Gilman Trail by separating pedestrian and bicycle uses would provide adequate capacity to meet CMP demands.

LOS results for segments along the Burke-Gilman Trail were based on the Federal Highway Administration's Shared-Use Path Level of Service Calculator (SUPLOS). These results are anticipated to be similar to those presented in Alternative 1 (Chapter 5).

Bicycle Parking and Utilization

As described in the Affected Environment chapter, the University has effectively managed bicycle parking demand. As new buildings are constructed, bicycle parking will be provided. For these reasons, additional bicycle parking analysis was not conducted for any of the growth alternatives (Alternatives 1-4).

Quality of Bicycle Environment (Primary and Secondary Impact Zones)

Changes to bicycle travel associated with Alternative 2 are similar to Alternative 1; however, added bicycle travel demand would be lower in West Campus and greater in East Campus.

In addition to those mentioned above, the Seattle Bicycle Master Plan includes several proposed improvements within the primary and secondary impact zones.

Within the primary impact zone, planned improvements include:

- A protected bike lane running north/south along Roosevelt Way NE highlights bicycle connectivity improvements (recently installed)
- Protected bike lanes along 11th Avenue NE and 12th Avenue NE
- Protected bike lanes along NE 40th Street, west of Brooklyn Avenue NE that would connect with the existing cycling infrastructure on NE 40th Street, thereby improving connectivity to campus

Within the secondary impact zone, planned improvements include:

- A new protected bike lane along Ravenna Place NE that would provide a direct connection between the Burke-Gillman Trail and Ravenna Park
- A protected bike lane along 36th Avenue NE that would increase bicycle connectivity in the north/south directions
- A planned Neighborhood Greenway along Fairview Avenue E that would increase the cycle connection to campus from the south

6.4 TRANSIT

6.4.1 Performance Measures

The following transit-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development within 1/4 Mile of RapidRide
- Proportion of Development within 1/2 Mile of Light Rail
- Transit Stop Capacity
- Transit Travel Times and Delay
- Transit Loads at Screenlines

Proportion of Development within 1/4 Mile of RapidRide

This measure calculates the proportion of development within 1/4 mile of RapidRide service to the University of Washington. As shown in Table 6.5 below, 100 percent of the new development in the No Action Alternative, Alternative 1, and Alternative 2 would be within a 1/4-mile proximity of RapidRide.

Table 6.5
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RAPIDRIDE

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)
West	211,000	3,000,000	2,400,000
South	NA	1,350,000	1,350,000
Central	NA	900,000	900,000
East	NA	750,000	1,350,000
Total	**211,000**	**6,000,000**	**6,000,000**
Percent	***100%***	***100%***	***100%***

Proportion of Development within 1/2 Mile of Light Rail

This measure calculates the proportion of development within a 1/2-mile walkshed of light rail stations. This action includes the U District Station at Brooklyn Street between NE 45th and NE 43rd streets, assumed to be completed in 2021. Table 6.6 summarizes the square footage of development within a 1/2-mile walkshed of light rail in No Action, Alternative 1, and Alternative 2. Compared to Alternative 1, Alternative 2 development would be more significant in East Campus. However, much more of this East Campus development would fall outside the 1/2-mile walkshed of light rail stations, resulting in a lower overall coverage.

Table 6.6
PROPORTION OF DEVELOPMENT WITHIN 1/2 MILE OF LIGHT RAIL

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)
West	211,000	2,680,232	2,160,729
South	NA	1,350,000	1,350,000
Central	NA	900,000	900,000
East	NA	750,000	452,036
Total	**211,000**	**5,680,232**	**4,862,766**
Percent	***100%***	***89%***	***90%***

Transit Stop Capacity

This measure evaluates the number of buses that a transit stop can process in an hour. This analysis was performed for four pairs of stops on key transit corridors around the University of Washington: 15th Avenue NE, NE 45th Street, Montlake Boulevard and NE Pacific Street. The transit stop capacity and demand do not change by alternative. Therefore, the summary provided in Chapter 4, No Action Alternative, reflects the expected operations.

Transit Travel Times and Delay

Transit travel speeds do not vary between Development Alternatives. Transit origins around the campus are anticipated to attract similar numbers of patrons regardless of development. Therefore, the transit corridor speeds are the same as Alternative 1 (Chapter 5).

Transit Loads at Screenlines

See Chapter 5, Alternative 1.

6.5 VEHICLE

6.5.1 Performance Measures

Six measures of effectiveness were analyzed to evaluate the impact of the campus growth on the surrounding transportation network:

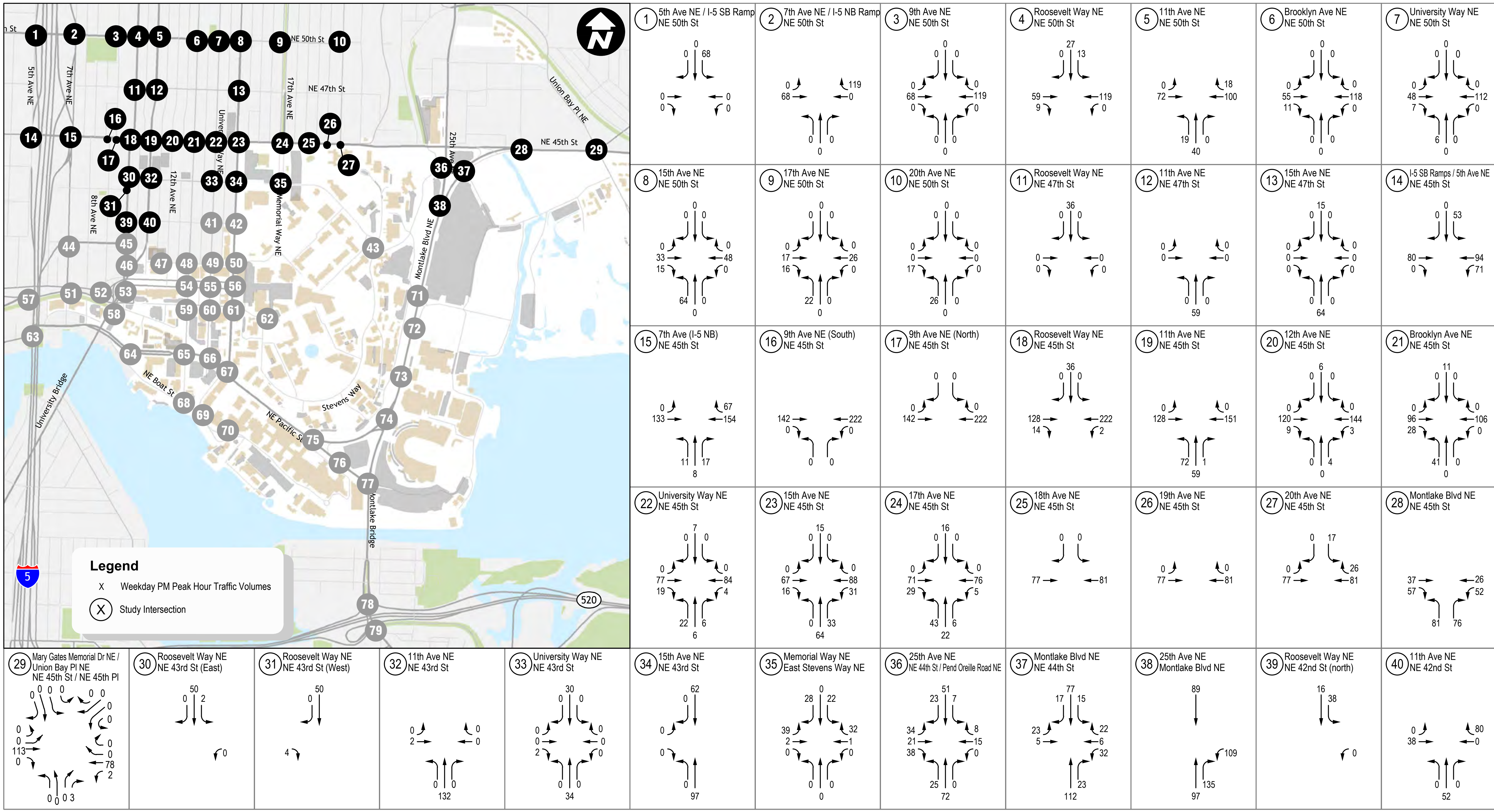
- Intersection operational level of service for intersection located in the primary and secondary impact area
- Arterial Corridor Operations
- Screenline Volumes
- Cordon Volumes
- Caps are set as 1990 trip levels to the University District and University (MIO)
- Freight Corridor Impact

6.5.2 Traffic Volumes

Increased vehicle traffic associated with Alternative 2 was assigned to potential garage locations based on existing vehicle travel patterns, previous studies in the project vicinity, review of University information, and U.S. Census Bureau's *OnTheMap* tool. *OnTheMap* is a web-based mapping and reporting application that shows where workers are employed and where they live based on census data. The ZIP codes within that data were evaluated to determine if a person would be more likely to travel from the ZIP code via vehicle or by other means. Individuals making trips to ZIP codes closer to the proposed project sites or in more transit-oriented locations are more likely to use transit, walk, bicycle, or other non-drive alone modes. Individuals making trips to ZIP codes outside the Seattle city limits and/or farther from the site are more likely to drive. The general trip distribution to/from the University of Washington is shown in Chapter 4, Impacts of No Action.

Primary Impact Zone

Project trips for each potential garage location were assigned to the study intersections based on the general trip distribution patterns shown in Chapter 4. Project trips at each study intersection are shown in Figure 6.2 and Figure 6.3 below. The resulting Alternative 2 volumes are shown in Figure 6.4 and Figure 6.5.



Future (2028) Alternative 2 (Intersections 1-40) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE 6.2

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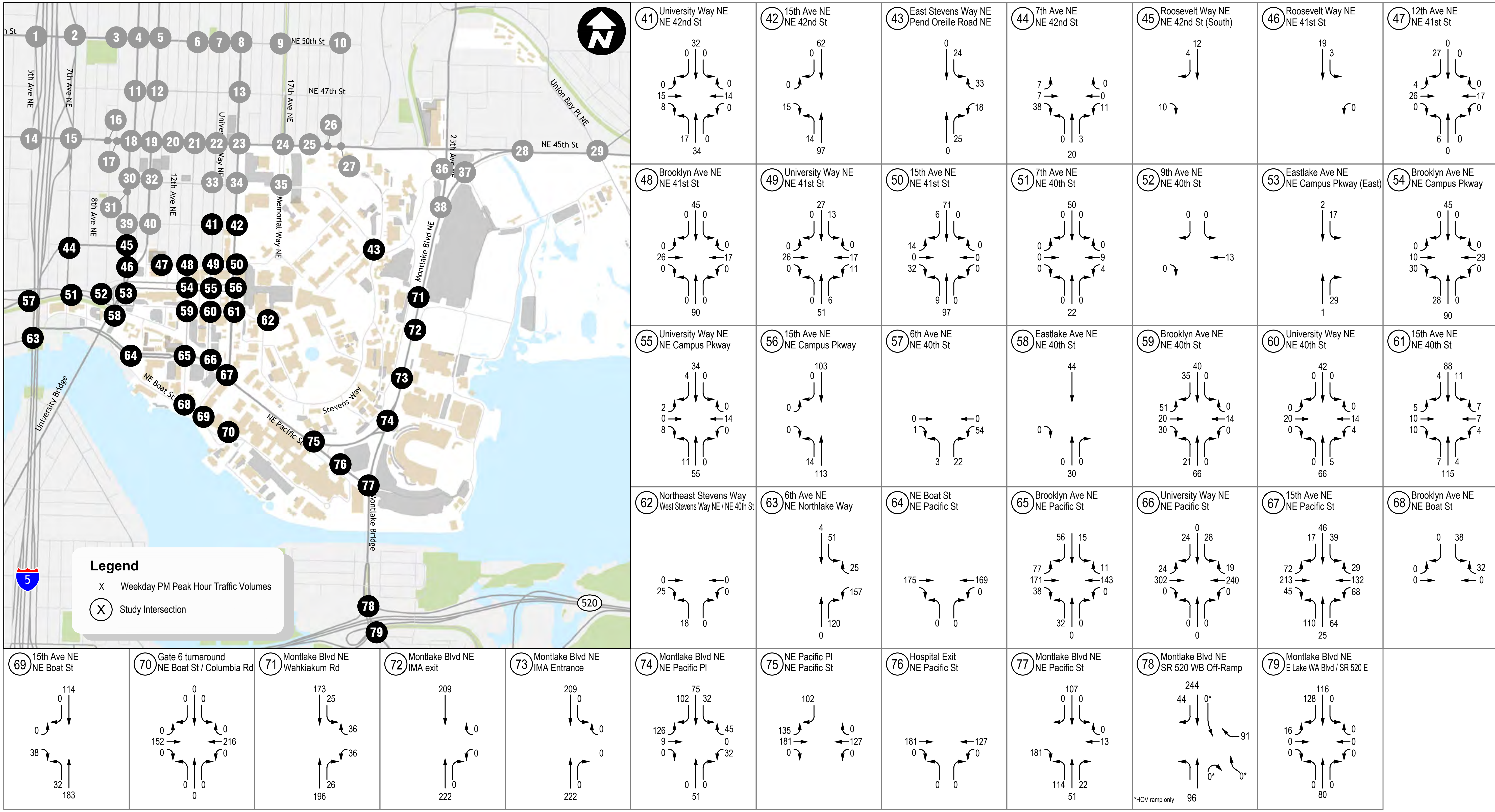

Future (2028) Alternative 2 (Intersections 41-79) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE
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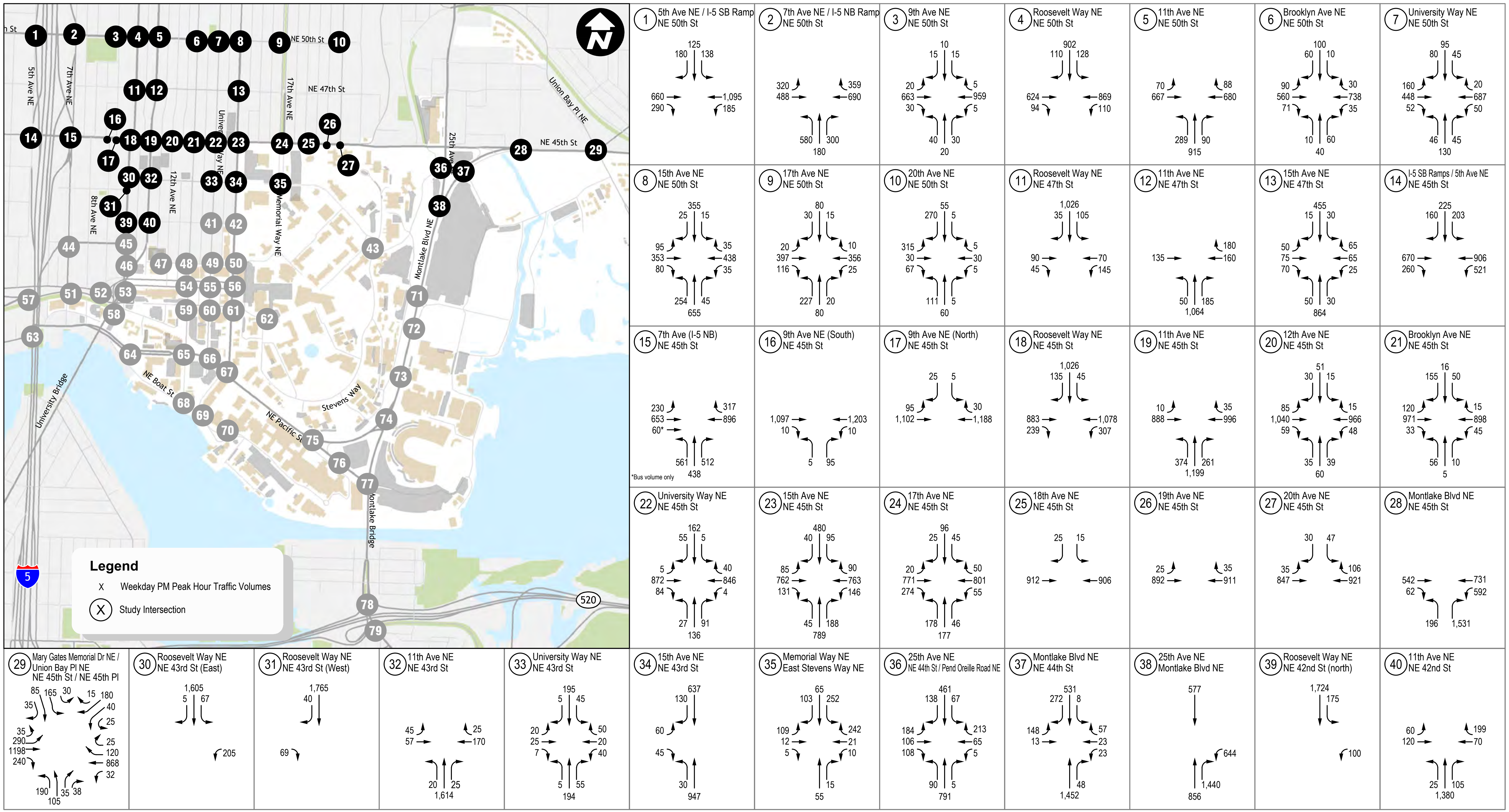

Future (2028) Alternative 2 (Intersections 1-40) Weekday PM Peak Hour Traffic Volumes

University of Washington 2018 Campus Master Plan

FIGURE **6.4**

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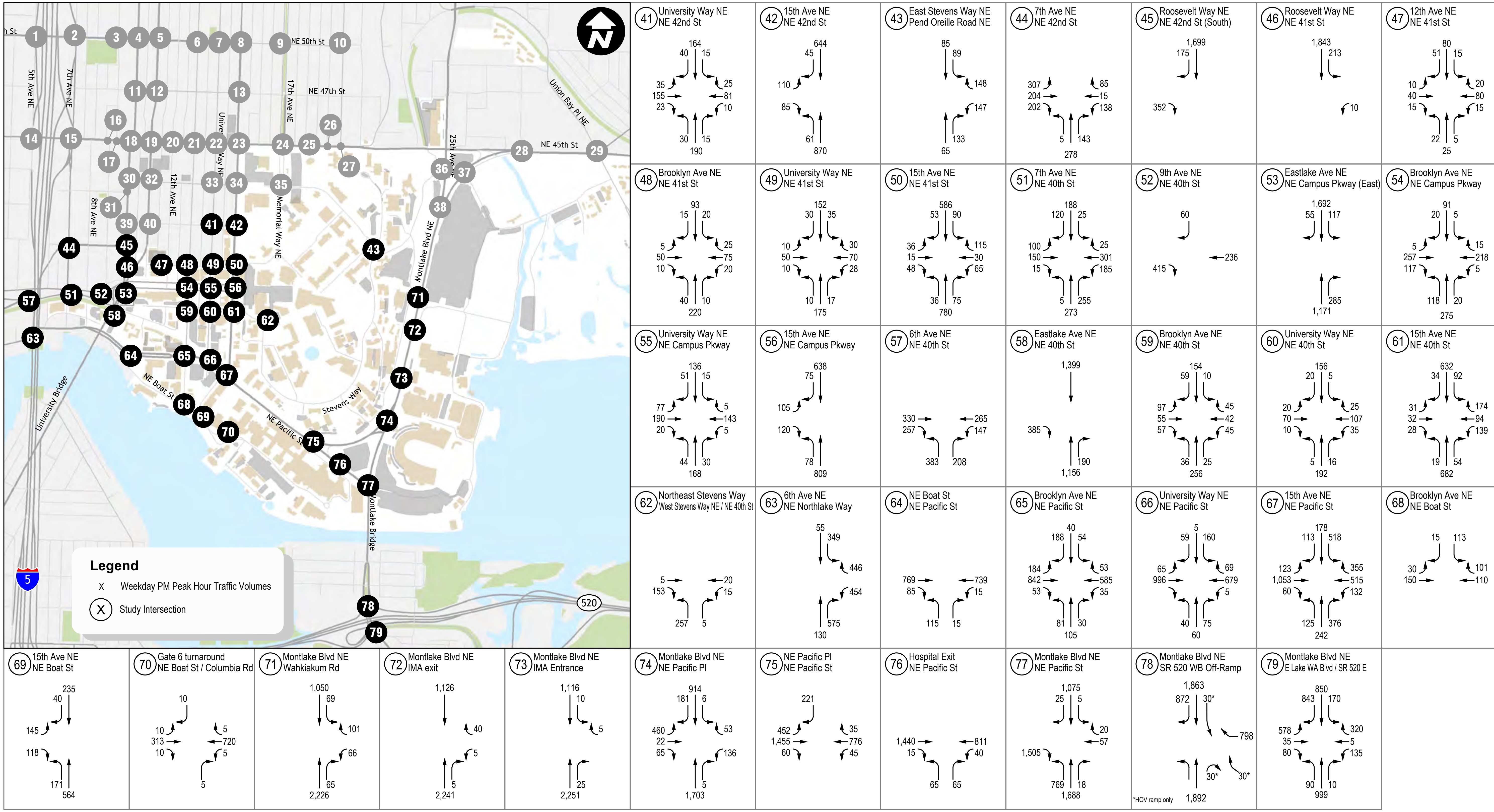

Future (2028) Alternative 2 (Intersections 41-79) Weekday PM Peak Hour Traffic Volumes

University of Washington 2018 Campus Master Plan

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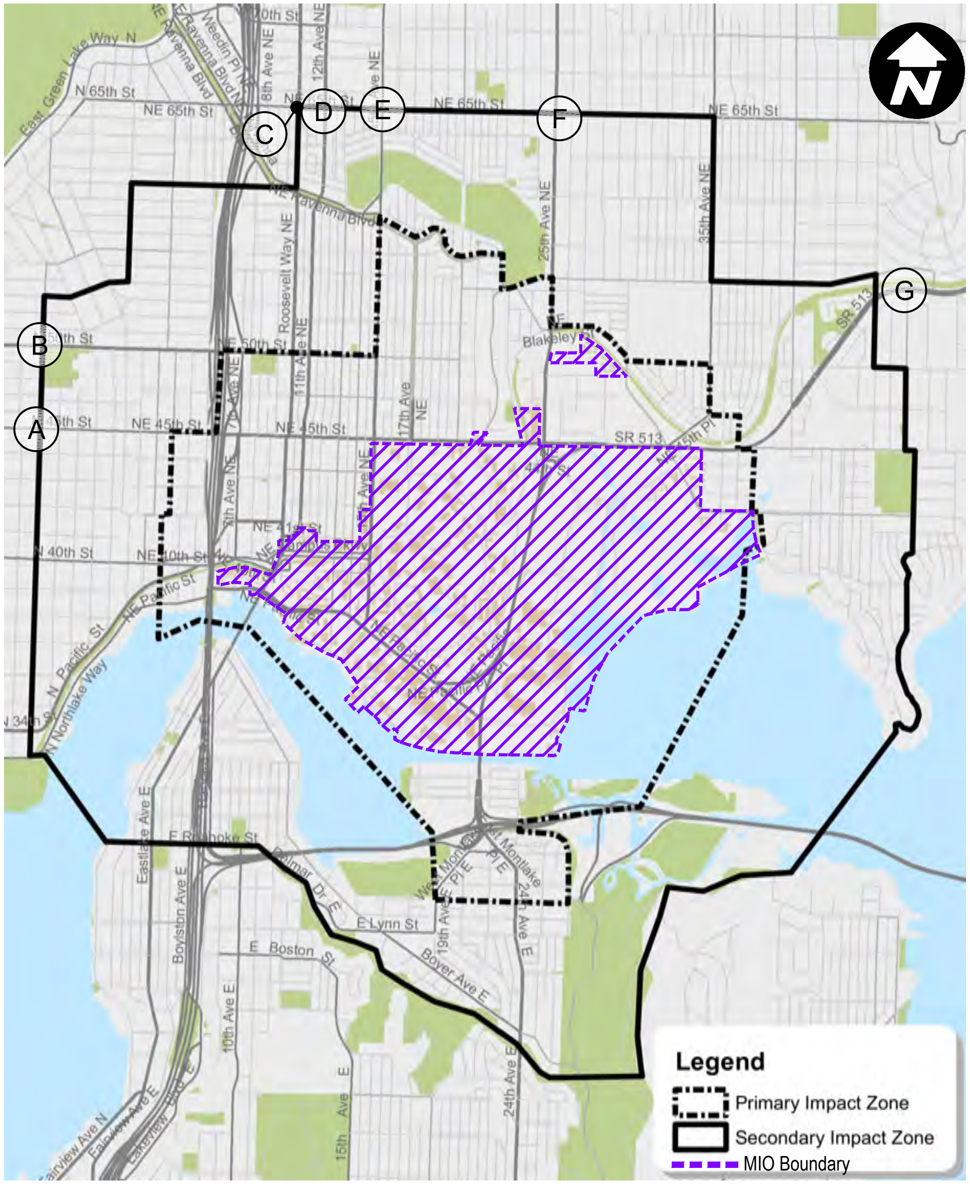
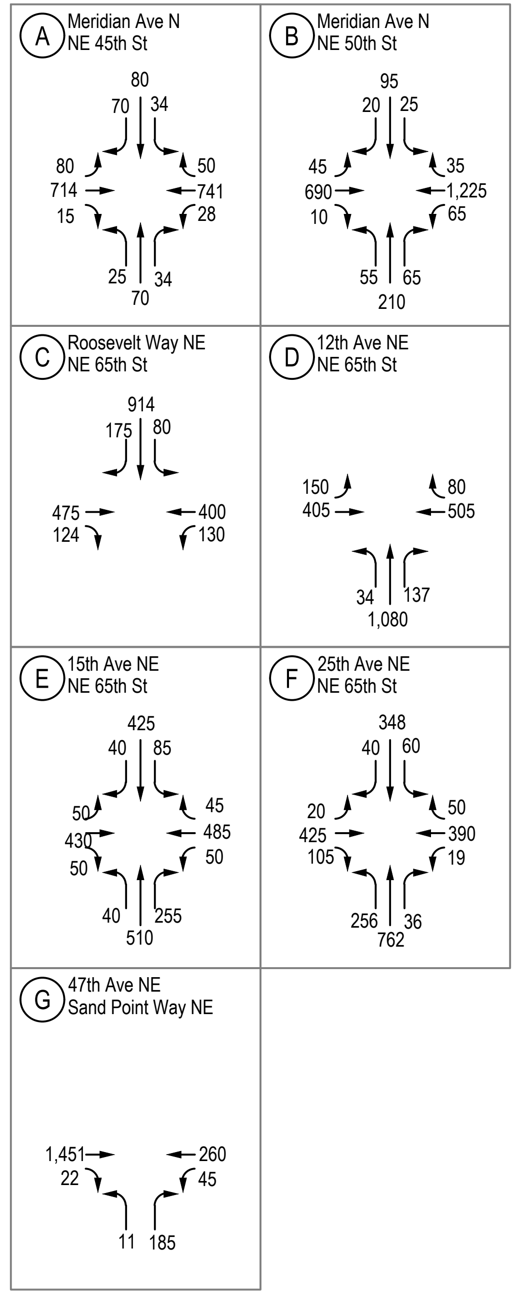
WHAT TRANSPORTATION CAN BE.

FIGURE
6.5

Secondary Impact Zone

Weekday PM peak hour volumes at seven intersections in the secondary impact zone were analyzed by considering future background traffic and volumes associated with the Alternative 2 development. Alternative 2 directional volumes were forecast in the same manner as all primary impact zone study intersections as described above. It was assumed that 5 percent of future volumes would be distributed into the neighborhood roadway network and therefore would not travel through the secondary impact zone study intersections. The resulting secondary impact zone volumes are shown in Figure 6.6.





Alternative 2 Secondary Impact Zone Weekday PM Peak Hour Traffic Volumes

FIGURE
6.6

University of Washington 2018 Campus Master Plan

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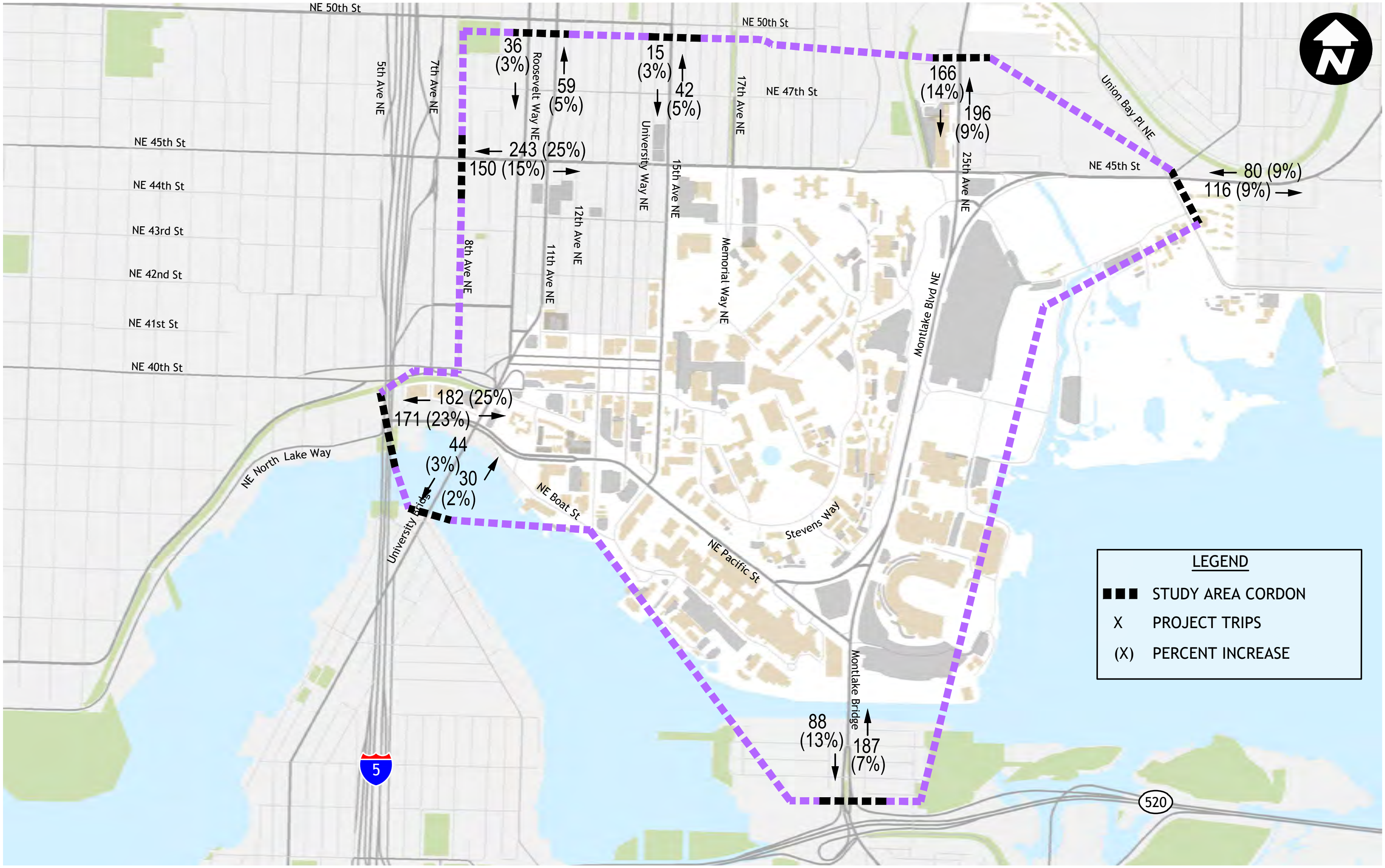
6.5.3 Cordon Volume Analysis

Cordon: An imaginary line used to evaluate traffic in and out of the University area and measure the change or increase in traffic associated with the proposed alternatives.

To understand the volumes considered under the different development alternative scenarios, a cordon volume analysis was completed. The cordon volume analysis focused on the major roadways leading to and from the University. The cordon volume analysis also showed the percent of total trips along the corridor that were associated with the increased traffic generated by Alternative 2. The cordon volume and project share associated with Alternative 2 are shown in Figure 6.7. Note that these data reflect the percentage increase associated with continued development on-campus. As shown in the figure, total project-related volumes would increase cordon volumes by 10–11 percent. Similar to Alternative 1, this increase could be constrained by the available arterial street capacity.



Future (2028) Alternative 2 PM Peak Hour Cordon Volumes and Proportional Increase

FIGURE

6.7

University of Washington 2018 Campus Master Plan

transpogroup
WHAT TRANSPORTATION CAN BE.

6.5.4 Traffic Operations Performance

Methodology

The methodology used in assessing intersection and corridor LOS is consistent with that described for the Affected Environment (Chapter 3) and No Action Alternative (Chapter 4) scenarios. A detailed description of the methodology used can be found in Appendix B: Methods and Assumptions.

Intersection Operations – Primary Impact Zone

Weekday PM peak hour intersection traffic operations during the Alternative 2 conditions are summarized in Figure 6.8 and Figure 6.9. The year 2028 geometry for all of the study-area intersections was assumed to remain the same as No Action Alternative conditions. Additionally, signal timing splits and offsets were optimized under Alternative 2. Complete intersection LOS summaries are provided in Appendix C.

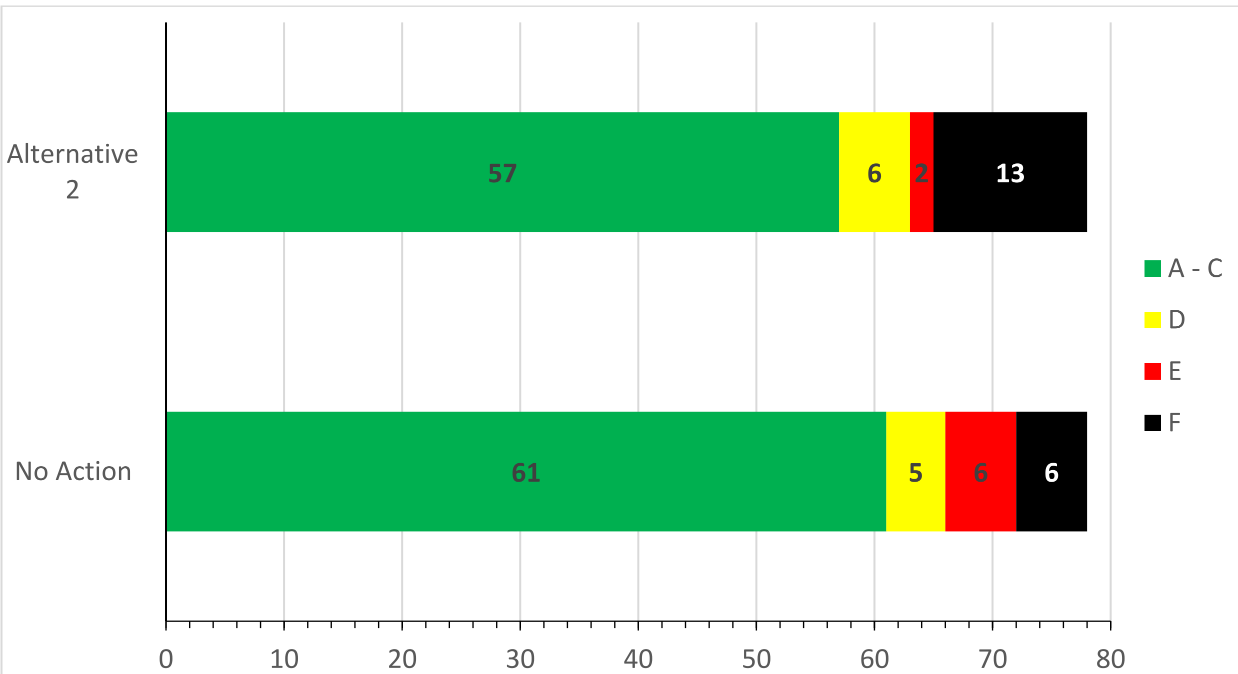


Figure 6.8 Weekday PM Intersection Level of Service Summary

The following table illustrates changes in intersection traffic operations at locations anticipated to operate at LOS E or F during the weekday PM peak hour under future Alternative 2 conditions.

Table 6.7
INTERSECTION LEVEL OF SERVICE SUMMARY

Intersection	No Action		Alternative 2		Change in Delay (sec)	Project Share
	LOS[1]	Delay[2]	LOS[1]	Delay[2]		
16. 9th Ave NE (south) / NE 45th St	E	41	F	67	26	15.9%
29. Montlake Blvd NE / Mary Gates Memorial Dr NE	D	50	E	58	8	5.2%
30. Roosevelt Way NE / NE 43rd St (east)	F	793	F	966	173	2.8%
31. Roosevelt Way NE / NE 43rd St (west)	F	74	F	113	39	2.9%
32. 11th Ave NE/NE 43rd St	E	72	F	105	33	7.2%
46. Roosevelt Way NE / NE 41st St	E	36	E	36	2	1.3%
47. 12th Ave NE / NE 41st St	F	52	F	426	374	24.6%
49. University Way NE / NE 41st St	F	*	F	*	*	28.7%
51. 7th Ave NE / NE 40th St	E	44	F	56	12	5.2%
57. 6th Ave NE / NE 40th St	F	107	F	128	21	5.1%
63. 6th Ave NE / NE Northlake Way	E	38	F	108	70	17.9%
67. 15th Ave NE / NE Pacific St	D	37	F	87	49	23.3%
69. 15th Ave NE / NE Boat St	C	18	F	96	78	31.4%
71. Montlake Blvd NE / Wahkiakum Rd	F	343	F	272	-71	13.1%
72. Montlake Blvd NE / IMA exit	D	34	F	57	23	12.2%

*Volume exceeds capacity and Synchro could not calculate the delay.

1. Level of service. 2. Average delay per vehicle in seconds rounded to the whole second.

During the weekday PM peak hour, eight additional intersections are anticipated to operate at LOS F under Alternative 2 traffic conditions compared to No Action conditions. Overall, 21 intersections are anticipated to operate at LOS D or worse during the weekday PM peak hour with Alternative 2, as compared to 17 under No Action conditions. The City of Seattle does not have an LOS standard, but generally considers LOS E and LOS F at signalized intersections and LOS F at unsignalized intersections to reflect poor operations. Intersections that degrade from LOS D to E or operate at LOS E or LOS F under the "with-project" condition, or increase by more than 5 or more seconds, could be considered significant by the City.

The following intersections are anticipated to degrade to LOS D or worse under Alternative 2 conditions:

16. 9th Avenue NE (South)/NE 45th Street
17. 9th Avenue NE (North)/NE 45th Street
29. Montlake Boulevard NE/Mary Gates Memorial Drive NE
32. 11th Avenue NE/ NE 43rd Street
51. 7th Avenue NE/ NE 40th Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
69. 15th Avenue NE/NE Boat Street
72. Montlake Boulevard NE/IMA Exit
73. Montlake Boulevard NE/IMA Entrance
77. Montlake Boulevard NE/NE Pacific Street

Intersections where the LOS would be E or F and where the Alternative 2 traffic would increase delay by more than 5 seconds are shown in Table 6.8. As shown in the table, a majority of the intersections is unsignalized. At the two-way stop controlled (TWSC) intersections, the change in delay is represented for the worst movement.

Table 6.8
POTENTIAL INTERSECTION OPERATIONS IMPACTS SUMMARY

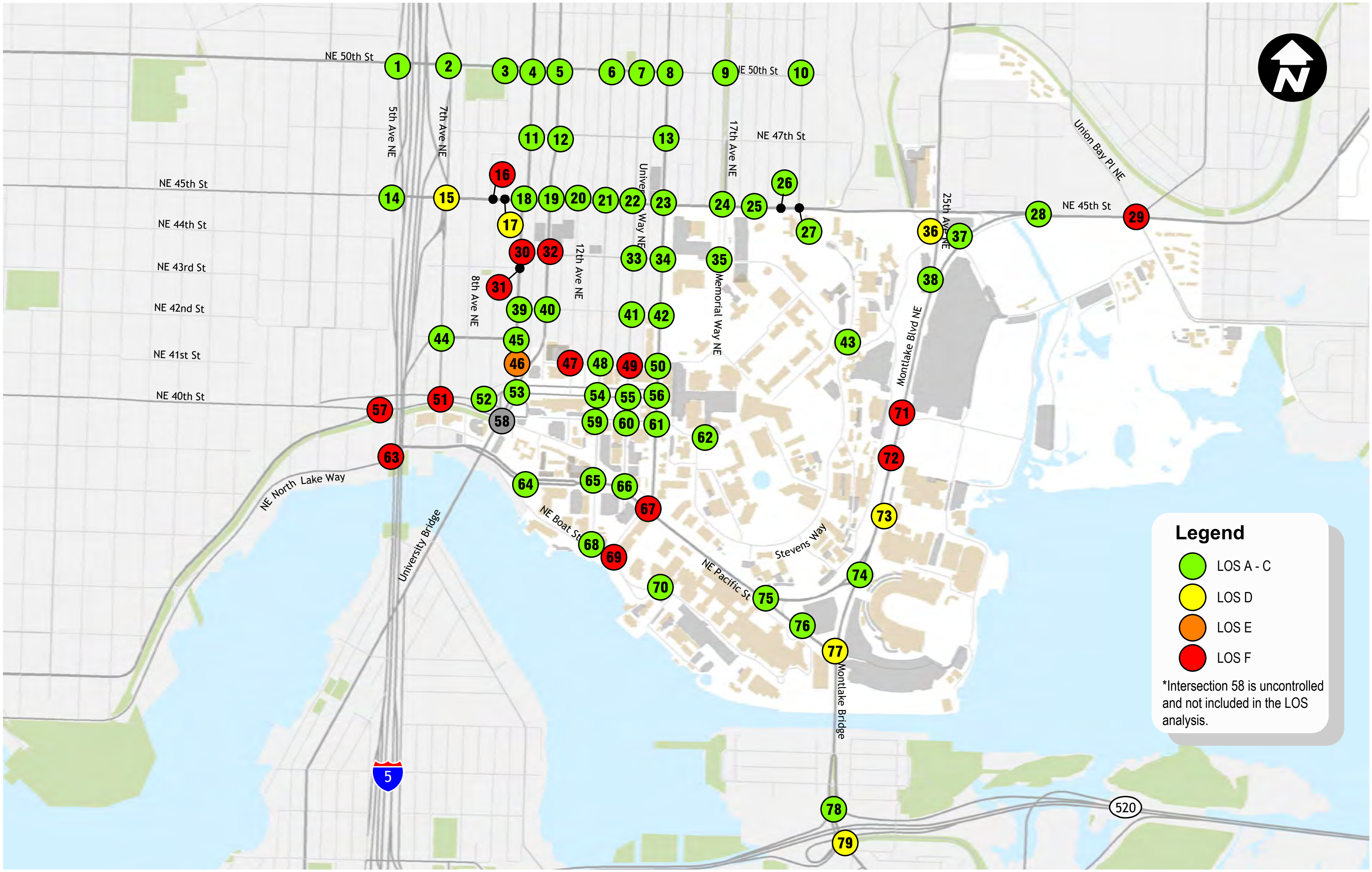
Intersection	Traffic Control	Change in Delay (Seconds)[1]	Percent of Total (Project Share)
16. 9th Avenue NE (south)/NE 45th Street	TWSC	26	15.9%
29. Montlake Boulevard NE/Mary Gates Memorial Drive NE	Signalized	73	5.2%
30. Roosevelt Way NE/NE 43rd Street (east)	TWSC	173	2.8%
31. Roosevelt Way NE/NE 43rd Street (west)	TWSC	39	2.9%
32. 11th Avenue NE/ NE 43rd Street	Signalized	33	7.2%
47. 12th Avenue NE/NE 41st Street	TWSC	374	24.6%
49. University Way NE/NE 41st Street	TWSC	-[2]	28.7%
51. 7th Avenue NE / NE 40th Street	AWSC	12	5.2%
57. 6th Avenue NE / NE 40th Street	AWSC	21	5.1%
63. 6th Avenue NE / NE Northlake Way	AWSC	70	17.9%
67. 15th Avenue NE / NE Pacific Street	Signalized	49	23.3%
69. 15th Avenue NE / NE Boat Street	AWSC	78	31.4%
72. Montlake Boulevard NE / IMA exit	TWSC	23	12.2%

1. Change in worst movement delay for two-way stop controlled (TWSC) intersections.
2. Volume exceeds capacity and Synchro could not calculate the delay.

Of the stop controlled intersections listed in Table 6.8, some of the increased delay could be attributed to higher pedestrian and bicycle volumes. Additionally, the following intersections are located at or near potential garage access locations resulting in a higher share of alternative percentages:

47. 12th Avenue NE/NE 41st Street
49. University Way NE/NE 41st Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
69. 15th Avenue NE/NE Boat Street
71. Montlake Boulevard NE / Wahkiakum Road
72. Montlake Boulevard NE/IMA exit

Driveways and building access features to be incorporated into planned development can have impacts on the overall trip distribution and individual movements at intersections near these locations. Given the preliminary planning nature of this evaluation, individual traffic impacts should be assessed when final building size and driveway locations are determined. Also, given the grid network, it is anticipated that if drivers experience long delays at unsignalized locations they could alter their trip patterns to reduce delays. Similar to Alternative 1, the LOS for vehicle traffic, while a consideration, must be increasingly balanced against the assumption that pedestrian, bicycle, and transit travel modes would be encouraged and facilitated. Intersections that are calculated to operate at poor LOS for vehicle traffic are not always considered a high priority for improvements by the City.



Future (2028) Alternative 2 Weekday PM Peak Hour Traffic Operations

FIGURE 6.9

University of Washington 2018 Campus Master Plan

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Intersection Operations – Secondary Impact Zone

Weekday PM peak hour intersection traffic operations under the 2028 No Action Alternative and Alternative 2 conditions are shown in Table 6.9. The 2028 geometry for all of the study area intersections were assumed to remain the same as existing conditions. Signal timing splits were optimized under 2028 Alternative 2 conditions. Complete intersection LOS summaries are provided in Appendix C.

Table 6.9
INTERSECTION LEVEL OF SERVICE SUMMARY – SECONDARY IMPACT ZONE

Intersection	No Action		Alternative 2		Change in Delay (sec)
	LOS[1]	Delay[2]	LOS[1]	Delay[2]	
A. Meridian Avenue N/N 45th Street	B	12	B	13	1
B. Meridian Avenue N/N 50th Street	B	17	B	17	0
C. Roosevelt Way NE/NE 65th Street	E	73	F	80	7
D. 12th Avenue NE/NE 65th Street	C	23	C	22	-1
E. 15th Avenue NE/NE 65th Street	F	161	F	160	-1
F. 25th Avenue NE/NE 65th Street	E	80	F	112	32
G. 47th Avenue NE/Sand Point Way NE	D	30	F	59	29

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

As shown in Table 6.9 the secondary impact zone intersections are anticipated to operate at the same LOS under Alternative 2 as they do under the No Action Alternative conditions with the exception of the 25th Avenue NE/ NE 65th Street, 47th Avenue NE/ Sand Point Way NE, and Roosevelt Way NE/ NE 65th Street intersections. The 25th Avenue NE/ NE 65th Street intersection is anticipated to degrade from LOS E to LOS F with approximately a 32 second increase in delay. The 47th Avenue NE/ Sand Point Way NE intersection is anticipated to degrade from LOS D to LOS F with approximately a 29 second increase in delay. The Roosevelt Way NE/ NE 65th Street intersection is anticipated to degrade from LOS E to LOS F with approximately a 7 second increase in delay. Additionally, the 15th Avenue NE/NE 65th Street and 12th Avenue NE/ NE 65th Street intersections are anticipated to experience a slight decrease in delay.

6.5.5 Arterial Operations

Arterial travel times and speeds were evaluated along NE 45th Street, Pacific Street, 11th Avenue NE, Roosevelt Way NE, 15th Avenue NE, Montlake Boulevard NE, and Stevens Way NE, along with traffic data associated with Alternative 1. These data are consistent with the previously described methodology for both existing and future No Action conditions. This includes the application of the adjustment factors previously described.

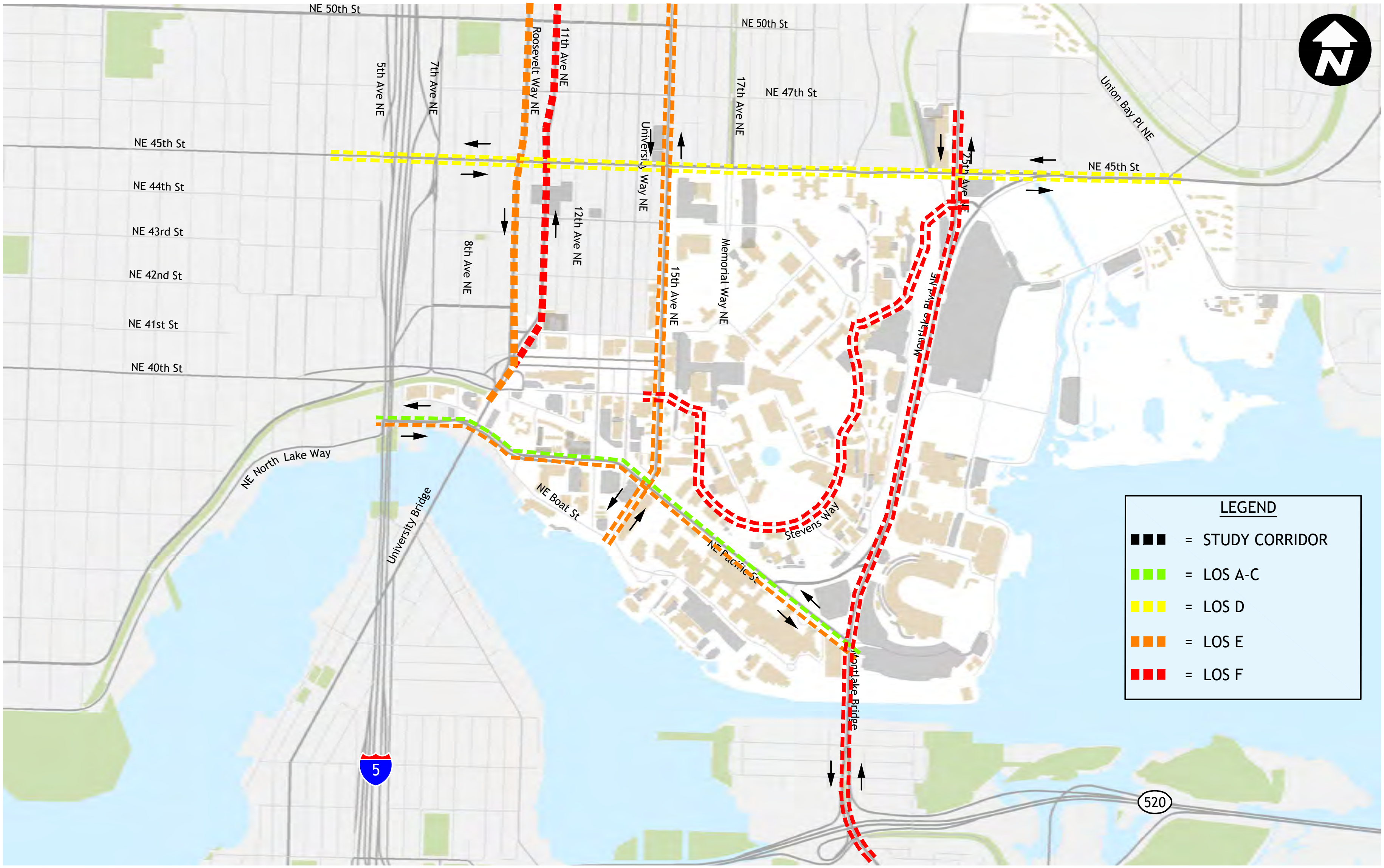
Table 6.10 and Figure 6.10 summarize weekday PM peak hour arterial travel times and speeds. Detailed arterial operations worksheets are provided in Appendix C.

Table 6.10
WEEKDAY PM PEAK HOUR ARTERIAL LEVEL OF SERVICE SUMMARY

Corridor	No Action		Alternative 2	
	LOS[1]	Speed[2]	LOS[1]	Speed[2]
11th Avenue NE between NE Campus Parkway and NE 50th Street				
Northbound	F	5.0	F	4.0
15th Avenue NE between NE Boat Street and NE 50th Street				
Northbound	E	8.0	E	7.3
Southbound	D	9.2	E	7.1
Montlake Boulevard NE between E Lake Washington Boulevard and NE 45th Street				
Northbound	E	11.5	F	9.7
Southbound	F	8.5	F	8.4
NE 45th Street between 5th Avenue NE and Union Bay Place NE				
Eastbound	D	12.0	D	11.9
Westbound	D	11.6	D	10.6
NE Pacific Street (NE Northlake Way) between 6th Avenue NE and Montlake Boulevard E				
Eastbound	C	18.3	E	11.1
Westbound	C	21.9	C	20.6
Roosevelt Way NE between NE Campus Parkway and NE 50th Street				
Southbound	D	10.4	E	8.9
Stevens Way NE between 15th Avenue NE and 25th Avenue NE				
Eastbound	F	3.6	F	3.5
Westbound	F	3.1	F	2.3

1. Level of service.
2. Average speed in miles per hour

As shown in Table 6.10, with Alternative 2 the arterials would experience increases in delay and slower travel speeds. Anticipated LOS expected is as follows: Southbound 15th Avenue NE (from LOS D to LOS E), northbound Montlake Boulevard NE (from LOS E to LOS F), eastbound NE Pacific Street (from LOS C to LOS E), and southbound Roosevelt Way NE (from LOS D to LOS E).



Future (2028) Alternative 2 Weekday PM Peak Hour Corridor Traffic Operations

FIGURE
6.10

University of Washington 2018 Campus Master Plan

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WHAT TRANSPORTATION CAN BE.

6.5.6 Screenline Analysis: Primary Impact Zone

This section describes the analysis completed for two designated screenlines within the study area, consistent with City of Seattle Transportation Concurrency system. Screenlines are imaginary lines across which the number of passing vehicles is counted. In this study, screenlines were selected to count vehicle traffic entering and exiting the University of Washington primary and secondary impact zones. As part of the Mayor's Seattle 2035 Comprehensive Plan (City of Seattle, 2016), two screenlines were identified within the vicinity of the University of Washington, as shown in Figure 6.11. Screenline 5.16 is an east-west screenline, measuring north-south travel, and extending along the ship canal to include the University and Montlake bridges. Screenline 13.13 is a north-south screenline, measuring east-west travel, and extending east of Interstate 5 (I-5) between NE Pacific Street and NE Ravenna Boulevard.

Screenline: An imaginary line across which the number of passing vehicles is counted.

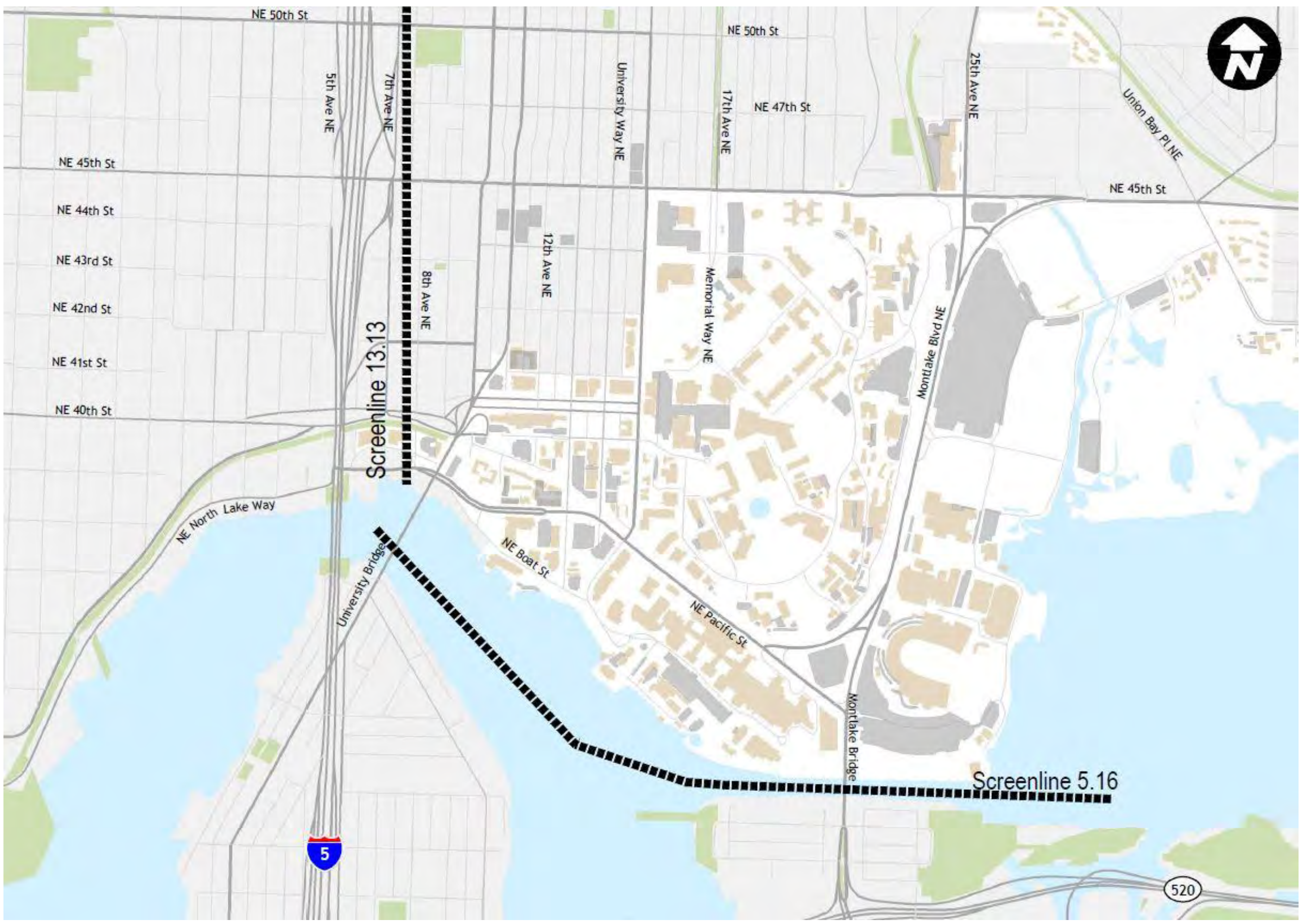


Figure 6.11 Study Area Screenlines

The screenline analysis included volume-to-capacity (V/C) calculations for the vehicles traversing the screenlines using Alternative 2 traffic volumes and interpolated roadway capacity estimates. Roadway capacity for the 2028 future horizon year was interpolated using 2016 capacity estimates described in Chapter 3, Affected Environment, and 2035 capacity estimates referenced in the May 2016 Seattle Comprehensive Plan Update Final EIS. Alternative 2 roadway capacity estimates are shown in Table 6.11 below. Detailed screenline volumes and V/C calculations are included in Appendix C.

Table 6.11
ROADWAY CAPACITY AT STUDY AREA SCREENLINES

Screenline	Alternative 2 Capacity
5.16 – Ship Canal, University and Montlake Bridges	
Northbound	4,210
Southbound	4,210
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard	
Eastbound	6,119
Westbound	6,119

Source: Transpo Group, 2016

LOS standards for the screenline analysis were based on the V/C ratio of a screenline. As described in the Seattle Comprehensive Plan Update EIS, the LOS standard V/C ratio for Screenline 5.16 and Screenline 13.13 were 1.20 and 1.00, respectively. For this study, screenline V/C ratios that did not exceed the LOS standard were considered acceptable. A summary of the Alternative 2 screenline analysis is shown in Table 6.12. Detailed screenline analysis calculations are included in Appendix C.

Table 6.12
SCREENLINE ANALYSIS SUMMARY

Screenline	Screenline Volume	Capacity	V/C	LOS Standard V/C
5.16 – Ship Canal, University and Montlake Bridges				
Northbound	4,052	4,210	0.96	1.20
Southbound	4,532	4,210	1.08	1.20
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard				
Eastbound	3,641	6,119	0.60	1.00
Westbound	3,905	6,119	0.64	1.00

Source: NACTO, Seattle Comprehensive Plan Update EIS, and Transpo Group, 2016

As shown in Table 6.12, all Alternative 2 screenline V/C ratios would meet the acceptable LOS standard.

6.5.7 Service/Freight Routes

Campus-wide, the overall freight/service-related activities with Alternative 2 are anticipated to be similar to that planned for Alternative 1 as the total development area for each is the same. Increase in volume would shift based on the allocation of development area. With Alternative 2, comparative increases in campus development-related freight and service activity would occur mostly in the East campus sector, accessed off Montlake Boulevard. Therefore, no significant impact due to added freight traffic associated with Alternative 2 was identified.

6.5.8 Parking

Parking Supply

Similar to Alternative 1, it was assumed that parking supply would be increased or decreased within each campus sector to achieve an 85-percent utilization without exceeding the Alternative 2 parking cap of 10,250 spaces. The location of parking and strategies used to maintain the existing City University Agreement (CUA) parking cap would be consistent with those outlined for Alternative 1.

Parking Demand

Overall parking demand for Alternative 2 would be the same as Alternative 1. Alternative 2 on-campus parking demand and utilization was reviewed by campus sector to provide context on where parking demand would occur (see Table 6.13). Allocation of Alternative 2 parking demand by sector was based on projected development as documented in Appendix B, Methods and Assumptions. This evaluation assumed that on-street parking would be allocated to on-campus facilities given the increases and reallocation of parking supply to achieve an 85-percent utilization.

Table 6.13
PEAK PARKING DEMAND BY SECTOR

Sector	Future Cap Parking Supply	Parking Demand			% Utilization
			Alternative 2		
		No Action[1]	Growth[2]	Total	
West	2,590	1,428	775	2,203	85%
South	1,910	1,187	436	1,623	85%
Central	3,510	2,689	291	2,980	85%
East	2,240	1,464	436	1,900	85%
Total	**10,250**	**6,768**	**+1,938**	**8,706**	**85%**

Source: Transpo Group, 2016

1. On-campus parking demand for No Action based on projected increase in population. This does not include on-street parking demand increases noted in the previous table since these would not be parking within the Sectors.
2. Growth in parking demand based on projected increase in population for Alternative 2. The analysis assumes with the street vacation and reallocation of parking supply in Alternative 2, on-street parking demand would shift to on-campus parking.

As the table above reflects, reallocation of parking would result in a parking supply under the existing cap and an 85-percent utilization by campus sector and for the campus as a whole. The additional parking and reallocation of parking supply would provide a better relationship between localized supply and demand and thus reduce the likelihood of parking beyond University of Washington facilities (i.e., within the neighborhoods).

Secondary Parking Impacts

Parking outside the Primary Impact Zone would likely continue with Alternative 2 similar to the No Action Alternative. This could include people parking their vehicles in unrestricted spaces within areas served by transit and then using transit to travel to campus. With future campus growth, this could occur at higher levels compared to the No Action Alternative.

6.6 AERIAL/STREET VACATIONS

Alternative 2 impacts for the street vacation would be consistent with those described for Alternative 1 (Chapter 5). As noted in the Alternative 1 analysis, the City of Seattle has defined policies related to the assessing and approving the vacation of public rights-of-way. Further analysis would be provided to the City consistent with the policy requirements at such time an application for a street vacation is made. The EIS alternatives and supporting analysis reflect the vacation as proposed.

6.7 VEHICLE TRIP CAPS

CUA vehicle trip caps are considered campus-wide and would not materially change between the Development Alternatives. See discussion in Chapter 5, Alternative 1.

7 IMPACTS OF ALTERNATIVE 3

This chapter evaluates all modes of travel and compares **Alternative 3** to the No Action Alternative. Alternative 3 would encompass operations in the horizon year of 2028 with 6 million gross square footage of new development. The focus of those improvements would be primarily in the West and South campus sectors, with more limited development in the Central and East campus sectors.

This chapter summarizes the results of the analysis conducted for Alternative 3: Campus Development Reflecting increased West and South Campus Development. As in the previous chapters, the analysis examines the impacts to key transportation elements and transportation modes identified in Chapter 3, Affected Environment.

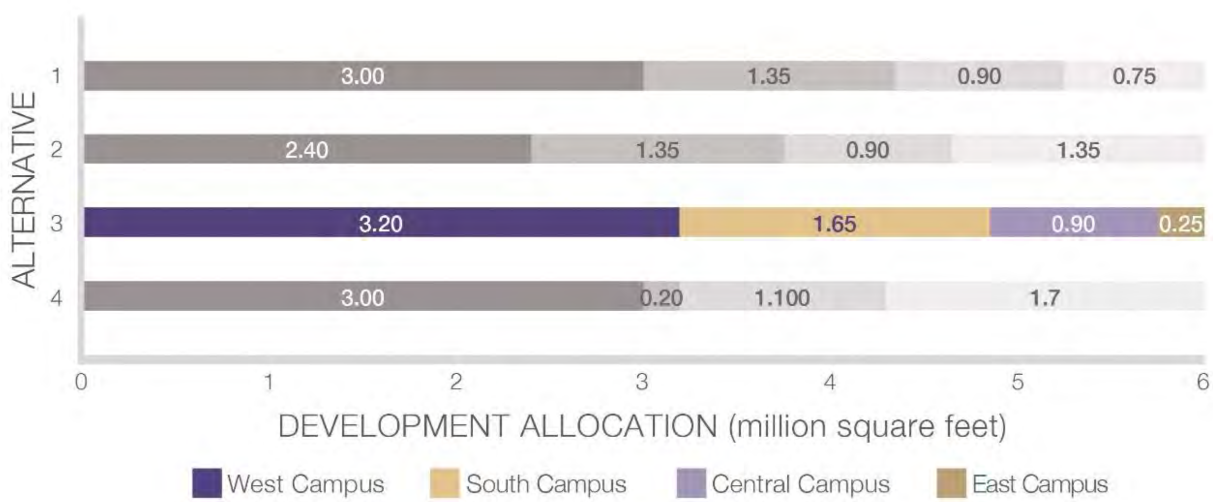
The No Action Alternative, used to compare existing conditions to Alternative 3, assumes a proportion of the development to be 211,000 gross square footage (gsf), as outlined in the City of Seattle adopted 2035 Comprehensive Plan and the adopted U District Rezone.

7.1 CHANGING CAMPUS CHARACTERISTICS

7.1.1 Description of the Alternative

The proposed University of Washington development under Alternative 3 is anticipated to be primarily located in the West and South campus sectors. The technical analysis of Alternative 3 focused on the weekday PM peak period.

Alternative 3 would include the development total of 6 million gsf throughout the campus, with a focus in the West and South Campus sectors and more limited development in the Central and East Campus sectors. Approximately 3.2 million gsf of development is proposed in West Campus and 1.65 million gsf would be developed in South Campus. The remaining development would be located in Central and East campus—approximately 900,000 gsf and 250,000 gsf, respectively. Figure 7.1 summarizes the Alternative 3 development allocation compared to the other development alternatives.



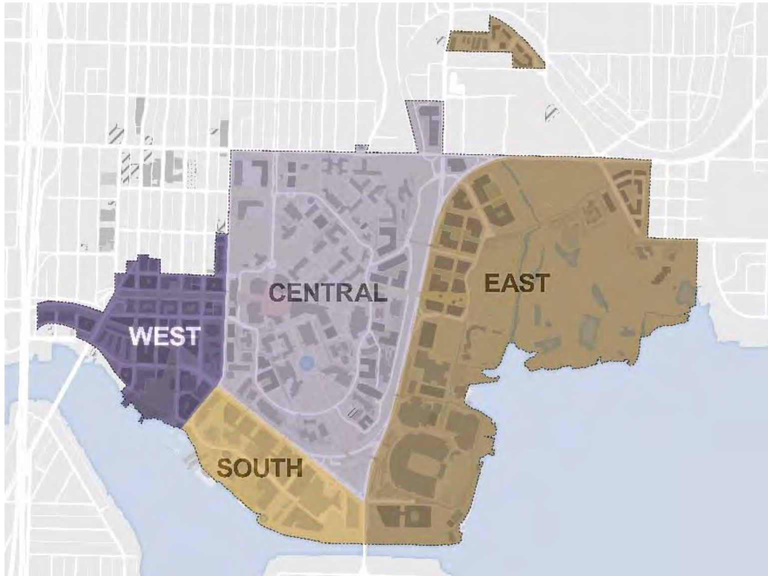


Figure 7.1 Alternative 3 Development Allocation

7.1.2 Trip Generation by Mode

This section summarizes the anticipated Alternative 3 trip generation for pedestrian, bicycle, transit, and vehicle trips to campus.

The trip generation methodology used for assessing the increase in trips under Alternative 3 is consistent with that previously described in Chapter 4, Impacts of No Action, and is consistent with Alternatives 1 and 2.

7.2 PEDESTRIANS

7.2.1 Performance Measures

The following pedestrian-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development Within 1/4 mile of Multifamily Housing
- Proportion of Development Within 1/4 mile of University of Washington Residence Halls
- Quality of Pedestrian Environments
- Pedestrian Screenline Demand and Capacity
- Pedestrian Transit Station/Stop Area LOS

These measures reflect the effectiveness of the pedestrian network in providing safe and easy access to pedestrian destinations—specifically housing—and thereby maintaining a high walk mode choice on campus. Comparisons of Alternative 3 to the No Action Alternative is provided for each measure below.

Proportion of Development within 1/4 Mile of Multifamily Housing

Walking makes up nearly one-third of all existing campus-related trips to and from campus. Proximity of campus development to housing is therefore one important measure for assessing the propensity of people to walk. This measure assesses the proximity of the current campus buildings and development to nearby multifamily housing in the University District. As shown in Table 7.1, 64 percent of Alternative 3 development would be within 1/4 quarter mile of multifamily housing.

Table 7.1
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF MULTIFAMILY HOUSING

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)
West	211,000	3,000,000	3,000,000	3,200,000
South	NA	0	0	0
Central	NA	589,985	723,460	645,884
East	NA	0	897,964	0
Total	**211,000**	**3,589,985**	**4,021,424**	**3,845,884**
Percent	***100%***	***60%***	***67%***	***64%***

Proportion of Development within 1/4 mile of University of Washington Residence Halls

This performance measure assesses the proportion of new development within walking distance of campus residence halls. For this analysis, University of Washington residence halls were identified and then buffered by 1/4 mile. As shown in Table 7.2, 76 percent of the new development in Alternative 3 would be within 1/4 mile of University of Washington residence halls.

Table 7.2
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RESIDENCE HALLS

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)
West	211,000	3,000,000	3,000,000	3,200,000
South	NA	249,344	249,344	332,215
Central	NA	798,357	723,460	788,727
East	NA	750,000	1,350,000	206,691
Total	**211,000**	**4,797,701**	**4,722,804**	**4,527,632**
Percent	***100%***	***80%***	***79%***	***76%***

Quality of Pedestrian Environment (Primary and Secondary Impact Zones)

Alternative 3 impacts would be similar to Alternative 1 impacts. The primary difference would be less development in East Campus, which would result in fewer connections and a less developed pedestrian network.

In addition to the referenced upgrades, the City of Seattle's Pedestrian Master Plan highlights new Neighborhood Greenways that have been planned within the primary and secondary impact zones. In addition to the existing 12th Avenue NE Neighborhood Greenway, within the primary impact zone several new Neighborhood Greenways are planned:

- A southern extension of the existing 12th Avenue NE Neighborhood Greenway
- Walla Walla Road
- NE Boat Street from NE Pacific Street to 15th Avenue NE
- 20th Avenue NE north of 45th Street
- NE 47th Street west of 20th Ave NE
- NE Clark Road

The NE Boat Street Neighborhood Greenway will improve pedestrian connectivity from the Cheshiahud Lake Union Loop to the University of Washington campus. The 20th Avenue NE and NE 47th Street greenways will increase pedestrian connectivity to the secondary impact zone and connect to planned greenways, including 11th Avenue NE, NE 55th Street, and NE 62nd Street.

In the east section of the of the secondary impact zone, new Neighborhood Greenways are planned along 5th Avenue NE, NE 46th Street, and Keystone Place North. Planned improvements on the west side of the secondary impact zone include improvements to NE Surber Drive and NE 50th Street.

Pedestrian Screenline Capacity

The pedestrian screenline capacity analysis evaluates the peak hour demand, capacity, and level of service (LOS) at all at- and above-grade crossing locations along Montlake Boulevard NE, NE Pacific Street, 15th Avenue NE, and NE 45th Street. The following section summarizes pedestrian screenline volumes under Alternative 3.

Pedestrian Growth from Transit Ridership

Additional growth resulting from increased transit ridership was added to transit stop pedestrian volumes aggregated by screenline, similar to that described for Alternative 1 in Chapter 5. This growth would account for all new pedestrians in the University of Washington study area that would be generated specifically by additional net new transit trips to and from campus.

Pedestrian Growth From Alternative 3 Development

Pedestrian growth resulting from Alternative 3 was assumed to be relative to the No Action Alternative and evaluated using the same analysis process as for Alternative 1. Table 7.3 summarizes Alternative 3 peak hour pedestrian screenline volumes and LOS.

Table 7.3
PEAK HOUR PEDESTRIAN SCREENLINE VOLUME AND LEVEL OF SERVICE

Screenline	No Action Alternative		Alternative 3	
	Peak Hour Pedestrian Volume (People/hour)	Level of Service	Peak Hour Pedestrian Volume (People/hour)	Level of Service
Montlake Boulevard NE	14,770	A	16,437	A
NE Pacific Street	3,744	A	5,092	A
15th Avenue NE	12,078	A	16,882	A
NE 45th Street	2,272	A	2,614	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

As shown in Table 7.3, all Alternative 3 peak hour aggregate pedestrian volumes for all screenlines would be at LOS A.

Pedestrian Transit Stop Space Analysis

This measure evaluates the peak hour demand, capacity, and LOS at key transit stops along Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE. The following sections summarize the pedestrian space per person and LOS at these locations with Alternative 3 development.

Pedestrian Growth From Transit Ridership

Additional growth from increased transit ridership was added to transit stop pedestrian volumes aggregated by campus sector, similar to that described for Alternative 1 in Chapter 5. This growth would account for all new pedestrians in the University of Washington study area, generated specifically by additional net new transit trips to and from campus.

Pedestrian Growth From Alternative 3 Development

Pedestrian growth from Alternative 3 was assumed relative to the No Action Alternative and evaluated using the same analysis process as described for Alternative 1 in Chapter 5. Table 7.4 summarizes Alternative 3 peak hour pedestrian space and LOS at transit stops in the study area.

Table 7.4
PEAK HOUR TRANSIT STOP PEDESTRIAN SPACE AND LEVEL OF SERVICE

Stop Location	Stop ID Number	No Action Alternative		Alternative 3	
		Pedestrian Space (ft^2/person)	Level of Service	Pedestrian Space (ft^2/person)	Level of Service
NE Pacific Street Bay 1	1	45.0	A	10.7	B
NE Pacific Street Bay 2	2	39.0	A	10.2	B
NE Pacific Street at 15th Ave NE	3	7.5	C	1.7	F
15th Avenue NE at Campus Pkwy	4	62.4	A	8.3	C
15th Avenue NE at NE 42nd Street	5	50.5	A	6.5	D
15th Avenue NE at NE 43rd Street	6	27.8	A	7.1	C
Montlake Boulevard Bay 4	7	39.0	A	26.1	A
Montlake Boulevard Bay 3	8	108.7	A	72.8	A
Stevens Way at Pend Oreille Road	9	19.0	A	12.2	B
Stevens Way at Benton Lane	10	36.4	A	25.3	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

As shown in Table 7.4, Alternative 3 peak hour pedestrian space for all transit stops, with the exception of locations 3 and 5, would be LOS C or better. Location 3 (mid-block near the 15th Avenue NE/ NE Pacific Street intersection) and location 5 (at the 15th Avenue NE/ NE 42nd Street intersection) would be LOS F and LOS D, respectively.

7.3 BICYCLES

7.3.1 Performance Measures

The following bicycle-related performance measures have been identified to assess and compare alternatives:

- Burke-Gilman Trail Capacity
- Bicycle Parking and Utilization
- Quality of Bicycle Environment

Burke-Gilman Trail Capacity

Alternative 3 would generally have the same impact on the Burke-Gilman Trail pedestrian and bicycle demand as Alternative 1. However, due to the larger concentration of growth in West and South campus, high travel demand would be anticipated in these areas along and crossing the Burke-Gilman Trail. The East Campus would likely see the least growth in demand. Planned expansion of the Burke-Gilman Trail separating pedestrian and bicycle uses will provide adequate capacity to meet CMP demands.

Level of service results for segments along the Burke-Gilman Trail was based on the Federal Highway Administration's Shared-Use Path Level of Service Calculator (SUPLOS). These results are anticipated to be similar to those presented for Alternative 1 in Chapter 5.

Bicycle Parking and Utilization

As described in the Affected Environment chapter, the University has effectively managed bicycle parking demand. As new buildings are constructed, bicycle parking will be provided. For these reasons, additional bicycle parking analysis was not conducted for any of the growth alternatives (Alternatives 1-4).

Quality of Bicycle Environment (Primary and Secondary Impact Zones)

Alternative 3 would include the same general improvements to bicycle travel on campus as with Alternative 1, but with a greater concentration of added bicycle travel in the West and South campus sectors and less bicycle travel in East Campus.

The Burke-Gilman Trail would likely experience increased demand in the West and South campus sectors. The Alternative 3 focus on development in West Campus could result in trail facility improvements similar to those in the Mercer Court area. Increased cross-traffic and travel along the newly updated trail segment is anticipated in South Campus with Alternative 3. The Burke-Gilman Trail would provide better bicycle circulation from the southwest to the northeast areas of campus. Cross-traffic and travel along the older segment of the trail would increase in East Campus. Existing Pronto travel patterns indicate that East Campus bicycle travel may increase because the Burke-Gilman Trail provides a flat and direct route from East Campus to the South and West campus sectors.

In addition to the above-mentioned improvements, the Seattle Bicycle Master Plan includes several proposed improvements within the primary and secondary impact zones. These improvements include:

- Additional Neighborhood Greenways within the study area. These greenways would improve connectivity between bicycle environments throughout the study area, especially between the primary and secondary impact zones.
- The (recently installed) protected bike lane running north-south along Roosevelt Way NE highlights bicycle connectivity improvements within the primary impact zone.
- Protected bike lanes planned along 11th Avenue NE and 12th Avenue NE.
- Protected bike lanes planned along NE 40th Street, west of Brooklyn Avenue NE. This would connect with the existing bicycling infrastructure on NE 40th Street and improve connectivity to campus.

The following bicycle lane improvements are also planned within the secondary impact zone.

- A new protected bike lane along Ravenna Place NE, which would provide a direct connection between the Burke-Gillman Trail and Ravenna Park.
- A protected bike lane along 36th Avenue NE, which would increase bicycle connectivity in the north-south directions to the secondary impact zone.

- A planned Neighborhood Greenway along Fairview Avenue E, which would increase the bicycle connection to campus from the south.

7.4 TRANSIT

7.4.1 Performance Measures

Impacts of the No Action Alternative, Alternative 1, 2, and 3 on transit as compared to existing conditions is provided in this section. The following transit-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development Within 1/4 mile of RapidRide
- Proportion of Development Within 1/2 mile of Light Rail
- Transit Stop Capacity
- Transit Travel Times and Delay
- Transit Loads at Screenlines

Proportion of Development within 1/4 Mile of RapidRide

This measure calculates the proportion of development that occurs within 1/4 mile of RapidRide service to the University of Washington. As shown in Table 7.5, 100 percent of the new development with Alternative 3 would be within a 1/4 mile of RapidRide routes.

Table 7.5
PROPORTION OF DEVELOPMENT WITHIN 1/2 MILE OF RAPIDRIDE

Sector	No Action Alternative Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)
West	211,000	3,000,000	2,400,000	3,200,000
South	NA	1,350,000	1,350,000	1,650,000
Central	NA	900,000	900,000	900,000
East	NA	750,000	1,350,000	250,000
Total	**211,000**	**6,000,000**	**6,000,000**	**6,000,000**
Percent	***100%***	***100%***	***100%***	***100%***

Proportion of Development within 1/2 Mile of Light Rail

This measure evaluates the proportion of development within a 1/2-mile walkshed of Link light rail stations. Alternative 3 includes the U District Station on Brooklyn Avenue NE, assumed to be completed in 2021. .

Table 7.6 summarizes the square footage of development within a 1/2-mile walkshed of Link light rail station. As shown in this table, Alternative 3, like Alternative 1, would concentrate development in West and South Campus. This would result in 90 percent of the development being within the 1/2-mile walkshed to light rail stations.

Table 7.6
PROPORTION OF DEVELOPMENT WITHIN 1/2 MILE OF LIGHT RAIL

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)
West	211,000	2,680,232	2,160,729	2,880,973
South	NA	1,350,000	1,350,000	1,650,000
Central	NA	900,000	900,000	900,000
East	NA	750,000	452,036	250,000
Total	**211,000**	**5,680,232**	**4,862,766**	**5,680,973**
Percent	***100%***	***89%***	***90%***	***90%***

Transit Stop Capacity

Transit stop capacity measures the number of buses that a transit stop can process in an hour. This analysis was performed for four pairs of stops on key transit corridors around the University of Washington: 15th Avenue NE, NE 45th Street, Montlake Boulevard NE, and NE Pacific Street. The transit stop capacity and demand would not change by alternative. Therefore, the summary provided in Chapter 4, Impacts of No Action, reflects the expected operations.

Transit Travel Speeds

Transit travel speeds do not vary between development alternatives. Therefore, the transit corridor speeds under Alternative 3 would be the same as under Alternative 1 (see Chapter 5).

Transit Screenline Load Analysis

The transit screenline load analysis results for Alternative 3 are as described for Alternative 1 in Chapter 5.

7.5 VEHICLE

7.5.1 Performance Measures

Six measures of effectiveness were analyzed to evaluate the impact of the campus growth on the surrounding transportation network:

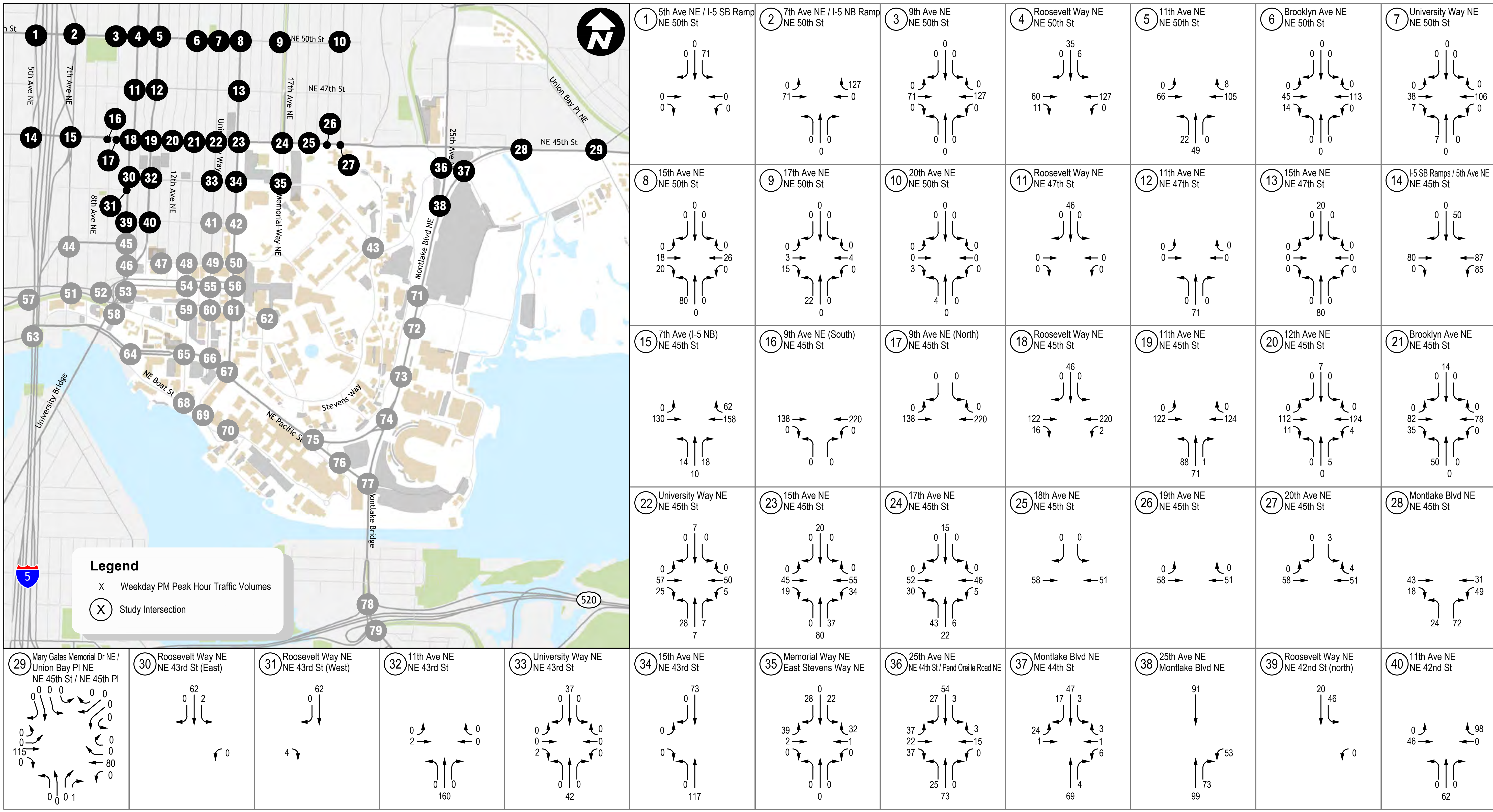
- Intersection operational level of service for intersection located in the primary and secondary impact area
- Arterial Corridor Operations
- Screenline Volumes
- Cordon Volumes
- Caps are set as 1990 trip levels to the University District and University (MIO)
- Freight Corridor Impact

7.5.2 Traffic Volumes

Increased vehicle traffic associated with Alternative 3 were assigned to potential garage locations based on existing vehicle travel patterns, previous studies in the project vicinity, review of University information, and U.S. Census Bureau's *OnTheMap* tool. *OnTheMap* is a web-based mapping and reporting application that shows where workers are employed and where they live, based on census data. The relevant ZIP codes were evaluated to determine if a person would be more likely to travel from the ZIP code via vehicle or by other means. Individuals making trip to ZIP codes closer to the proposed project sites or in more transit-oriented locations are more likely to use transit, walk, bicycle, or other non-drive alone transportation modes. Individuals making trips to ZIP codes outside the Seattle city limits and/or farther from the University of Washington are more likely to drive. The general trip distribution to/from the University is shown in Chapter 4, Impacts of No Action.

Primary Impact Zone

Vehicle trips for each potential Alternative 3 garage location were assigned to the study intersections based on the general trip distribution patterns shown in Chapter 4, Impacts of No Action. Project trips at each study intersection are shown on Figure 7.2 and Figure 7.3. The resulting Alternative 3 volumes are shown on Figure 7.4 and Figure 7.5.



Future (2028) Alternative 3 (Intersections 1-40) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE 7.2

transpogroup WHAT TRANSPORTATION CAN BE.

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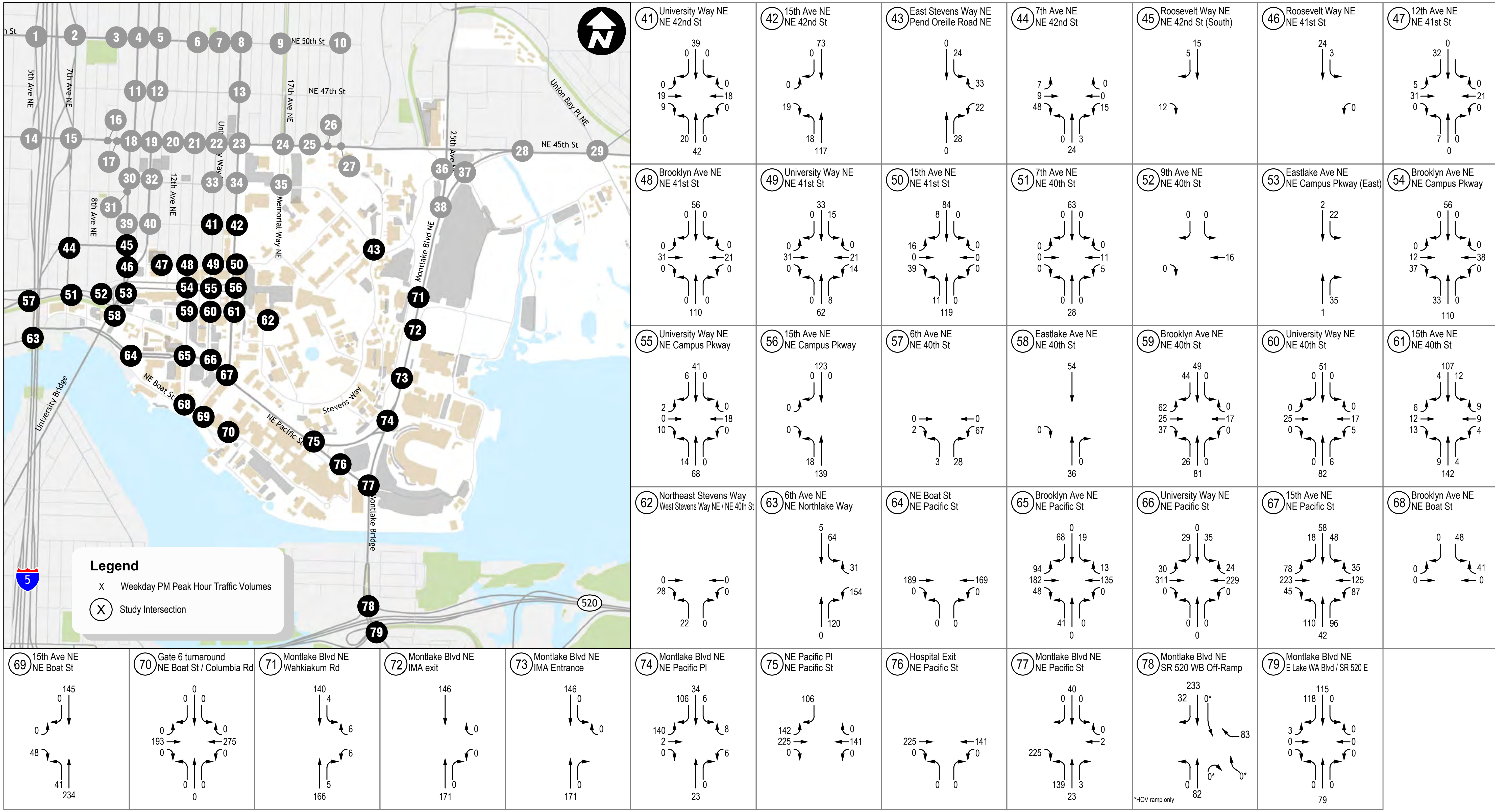

Future (2028) Alternative 3 (Intersections 41-79) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE 7.3

transpogroup WHAT TRANSPORTATION CAN BE.

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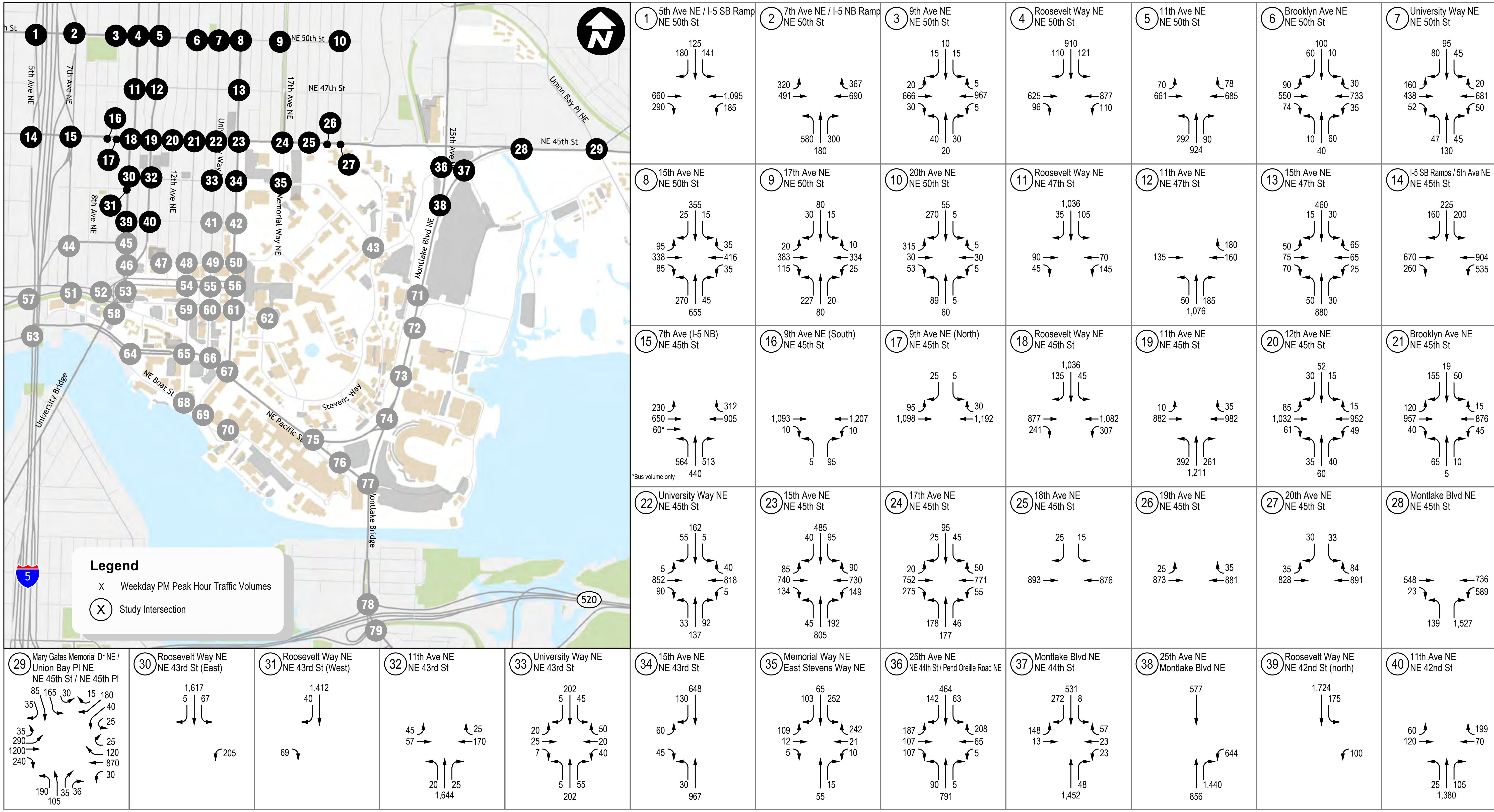

Future (2028) Alternative 3 (Intersections 1-40) Weekday PM Peak Hour Traffic Volumes

FIGURE
7.4

University of Washington 2018 Campus Master Plan

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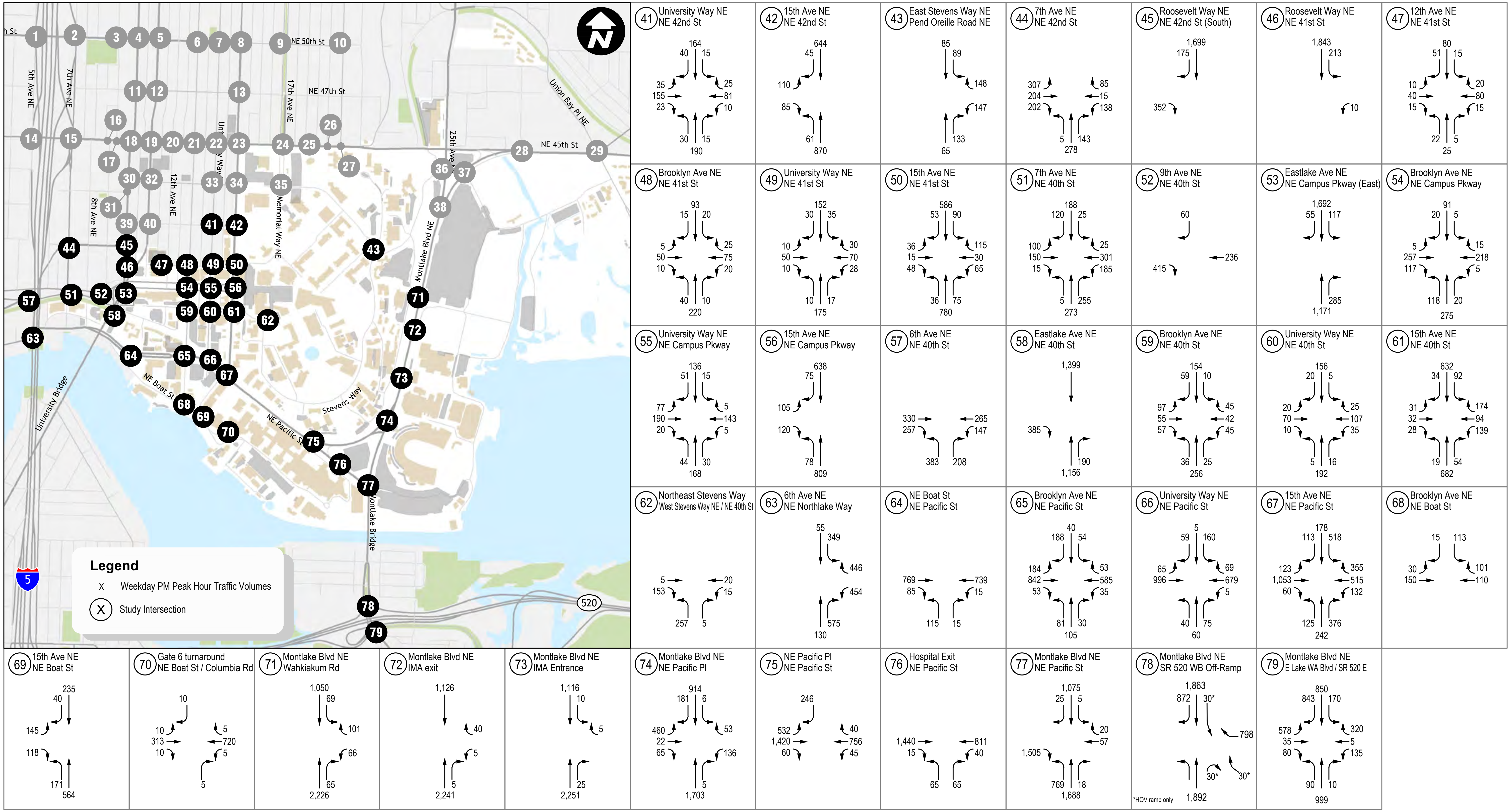
WHAT TRANSPORTATION CAN BE.



Future (2028) Alternative 3 (Intersections 41-79) Weekday PM Peak Hour Traffic Volumes

University of Washington 2018 Campus Master Plan

FIGURE **7.5**

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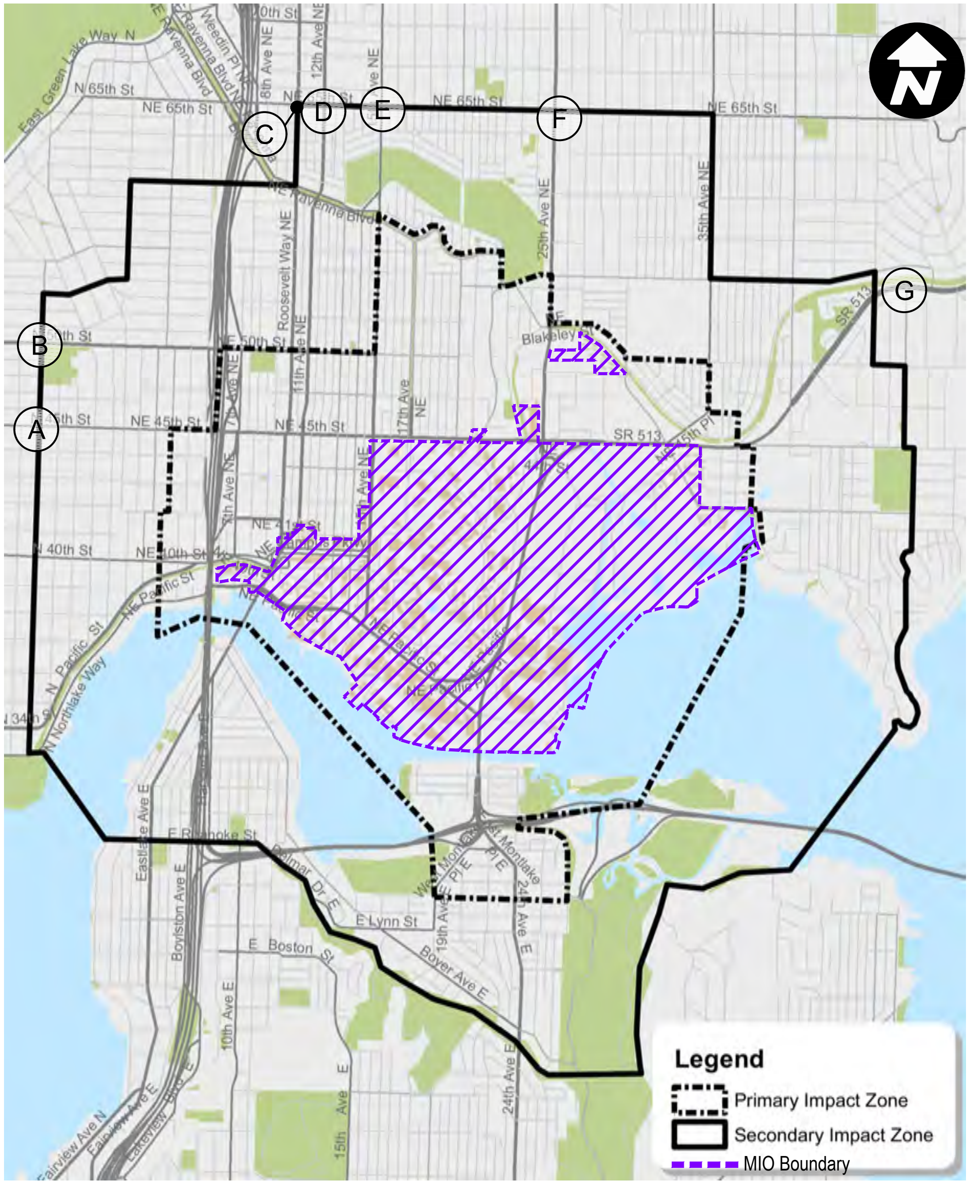
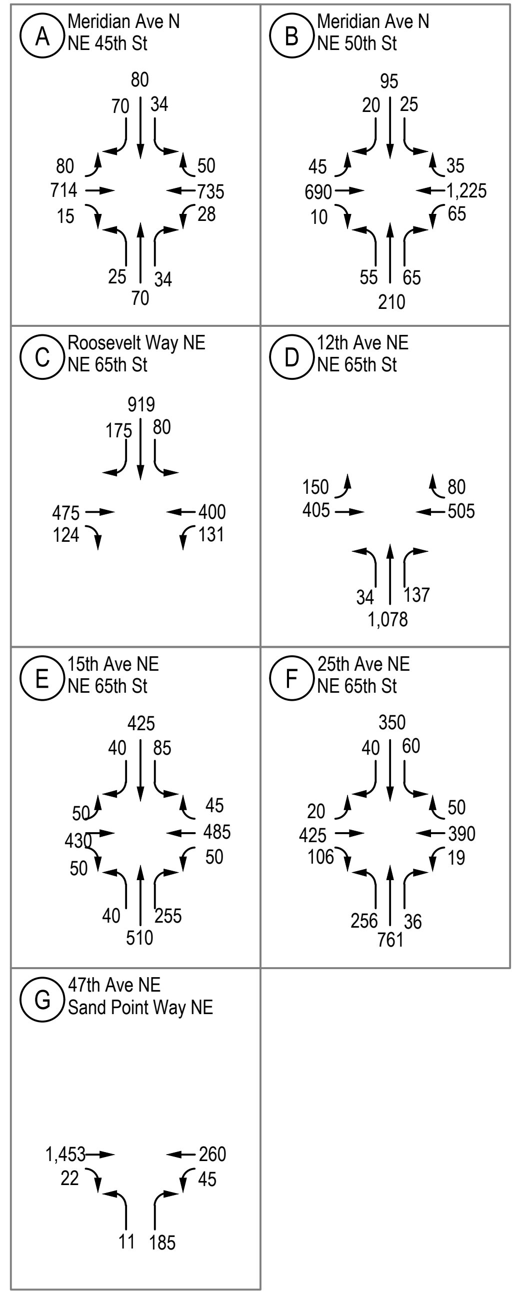
Secondary Impact Zone

Weekday PM peak hour volumes at seven intersections in the secondary impact zone were analyzed by considering future background traffic and volumes associated with the Alternative 3 development. Alternative 3 directional volumes were forecast in the same manner as all primary impact zone study intersections as described above. It was assumed that 5 percent of future volumes would be distributed into the neighborhood roadway network and therefore would not travel through the secondary impact zone study intersections. The resulting secondary impact zone volumes are shown in Figure 7.6.





Alternative 3 Secondary Impact Zone Weekday PM Peak Hour Volumes

FIGURE
7.6

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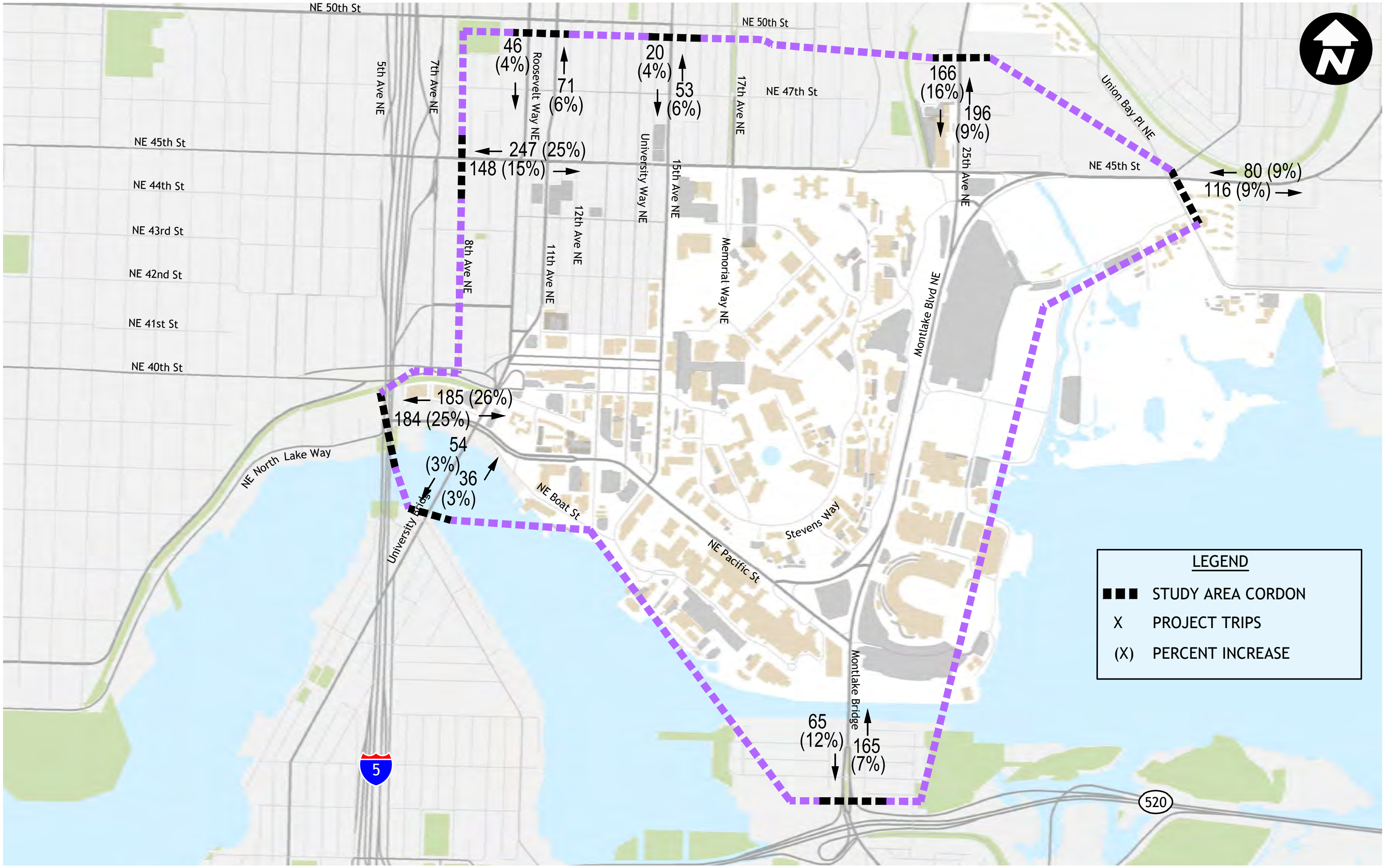
7.5.3 Cordon Volume Analysis

Cordon: An imaginary line used to evaluate traffic in and out of the University area and measure the change or increase in traffic associated with the proposed alternatives.

The proportionate share of traffic along the major roadways surrounding the University of Washington campus under Alternative 3 would be consistent with those previously described for Alternatives 1 and 2. The street vacation would have a minimal impact on the surrounding roadways. The proportionate share of University traffic is shown in Figure 7.7.



Future (2028) Alternative 3 PM Peak Hour Cordon Volumes and Proportional Increase

FIGURE **7.7**

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7.5.4 Traffic Operations Performance

Methodology

The methodology used in assessing intersection and corridor LOS for Alternative 3 is consistent with that described in Chapter 3, Affected Environment, and Chapter 4, Impacts of No Action Alternative. See Appendix B for a detailed description of methodology used.

Intersection Operations – Primary Impact Zone

Weekday PM peak hour intersection traffic operations under Alternative 3 are summarized in Figure 7.8 and Figure 7.9**.** The year 2028 geometry for all of the study area intersections were assumed to remain the same as No Action Alternative conditions, except when modifications are expected as part of Alternative 3. Additionally, signal timing splits and offsets were optimized under Alternative 3. Complete intersection level of service summaries are provided in Appendix C.

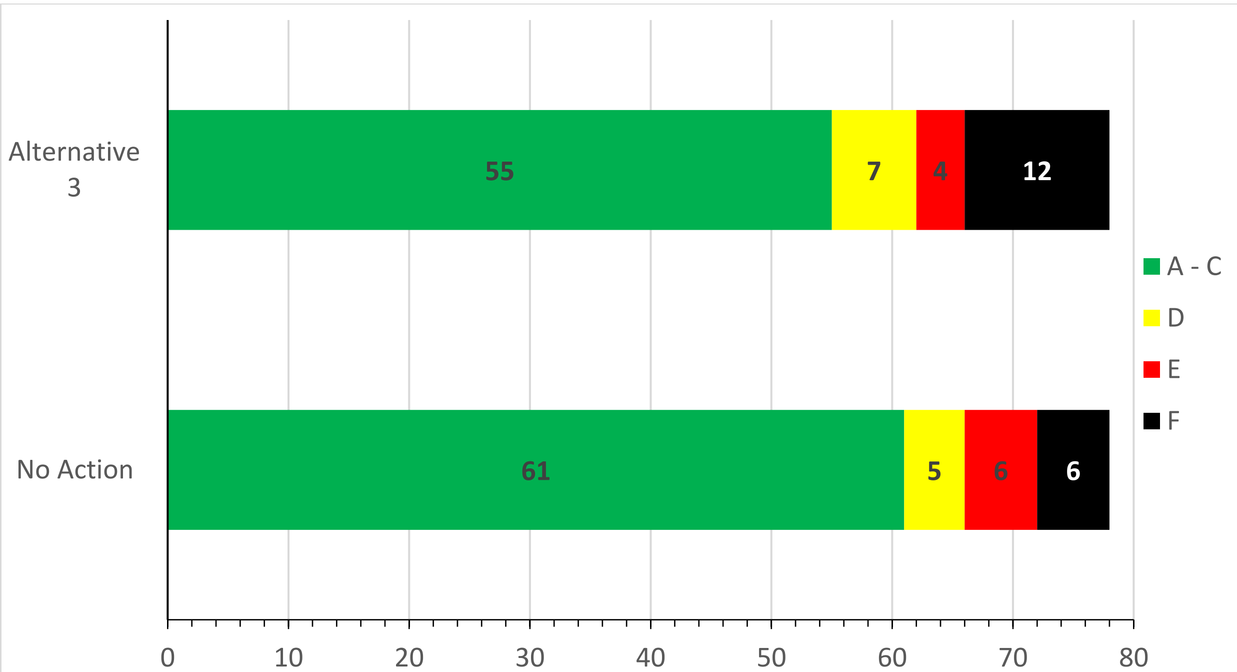


Figure 7.8 No Action/Alternative 3 Weekday 2028 Intersection Level of Service Summary

Table 7.7 illustrates changes in intersection traffic operations at intersections anticipated to operate at LOS E or F during the and Alternative 3 weekday PM peak hour.

Table 7.7
INTERSECTION LEVEL OF SERVICE PM PEAK HOUR SUMMARY

Intersection	No Action		Alternative 3		Change in Delay (sec)	Project Share
	LOS[1]	Delay[2]	LOS[1]	Delay[2]		
16. 9th Ave NE (South) / NE 45th St	E	41	F	67	26	15.9%
17. 9th Ave NE (North) / NE 45th St	C	23	E	36	13	15.7%
29. Montlake Blvd NE / Mary Gates Memorial Dr NE	D	50	E	57	7	5.2%
30. Roosevelt Way NE / NE 43rd St (East)	F	793	F	995	202	3.4%
31. Roosevelt Way NE / NE 43rd St (West)	F	74	F	113	39	3.5%
32. 11th Ave NE / NE 43rd St	E	72	F	111	39	8.6%
46. Roosevelt Way NE / NE 41st St	E	36	E	39	3	1.3%
47. 12th Ave NE / NE 41st St	F	52	F	664	612	24.6%
49. University Way NE / NE 41st St	F	*	F	*	*	28.7%
51. 7th Ave NE / NE 40th St	E	44	F	61	17	6.5%
57. 6th Ave NE / NE 40th St	F	107	F	108	1	6.3%
63. 6th Ave NE / NE Northlake Way	E	38	F	79	41	18.6%
67. 15th Ave NE / NE Pacific St	D	37	E	65	28	25.5%
71. Montlake Blvd NE / Wahkiakum Rd	F	343	F	3022	2679	9.1%
72. Montlake Blvd NE / IMA exit	D	34	E	42	8	9.3%

*Volume exceeds capacity and Synchro could not calculate the delay.

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

During the weekday PM peak hour, four additional intersections are anticipated to operate at LOS F with Alternative 3 as compared to No Action conditions. Overall, 23 intersections are anticipated to operate at LOS D or worse during the weekday PM peak hour under Alternative 3 conditions, as compared to 17 under No Action conditions. The City of Seattle does not have an LOS standard, but generally considers LOS E and LOS F at signalized intersections and LOS F at unsignalized intersections as poor operations. Intersections that degrade from LOS D to LOS E or operate at LOS E or LOS F under the "with-project" condition, or experience an increase of 5 or more seconds, could be considered a significant impact by the City.

The following intersections are anticipated to degrade to LOS D or degrade from LOS D to LOS E or worse under Alternative 3:

16. 9th Avenue NE (South)/NE 45th Street
17. 9th Avenue NE (North)/NE 45th Street
18. Roosevelt Way NE/NE 45th Street
23. 15th Avenue NE/NE 45th Street
29. Montlake Boulevard NE/Mary Gates Memorial Drive NE
32. 11th Avenue NE/ NE 43rd Street
51. 7th Avenue NE/NE 40th Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
69. 15th Avenue NE/NE Boat Street
72. Montlake Boulevard NE/IMA Exit
73. Montlake Boulevard NE/IMA Entrance

Intersections where the LOS would be E or F and where the Alternative 3 traffic increases would delay by more than 5 seconds are shown in Table 7.8. As shown in Table 7.8, most of the intersections are unsignalized. At the two-way, stop-controlled intersections, the change in delay is represented for the worst movement.

Table 7.8
ALTERNATIVE 3 INTERSECTION OPERATIONS POTENTIAL IMPACTS SUMMARY

Intersection	Traffic Control	Change in Delay (Seconds)	Percent of Total (Project Share)
16. 9th Avenue NE (south)/NE 45th Street	TWSC	26	15.9%
17. 9th Avenue NE (north)/NE 45th Street	TWSC	13	15.7%
29. Montlake Boulevard NE/Mary Gates Memorial Drive NE	Signalized	6	5.2%
30. Roosevelt Way NE/NE 43rd Street (east)	TWSC	201	3.4%
31. Roosevelt Way NE/NE 43rd Street (west)	TWSC	39	3.5%
32. 11th Avenue NE/NE 43rd Street	Signalized	41	8.6%
47. 12th Avenue NE/NE 41st Street	TWSC	612	24.6%
49. University Way NE/NE 41st Street	TWSC	-[1]	28.7%
51. 7th Avenue NE/NE 40th Street	AWSC	17	6.5%
57. 6th Avenue NE/NE 40th Street	AWSC	29	6.3%
63. 6th Avenue NE/NE Northlake Way	AWSC	72	18.6%
67. 15th Avenue NE/NE Pacific Street	Signalized	60	25.5%
71. Montlake Boulevard NE/Wahkiakum Road	TWSC	2,679	9.1%
72. Montlake Boulevard NE/IMA exit	TWSC	8	9.3%

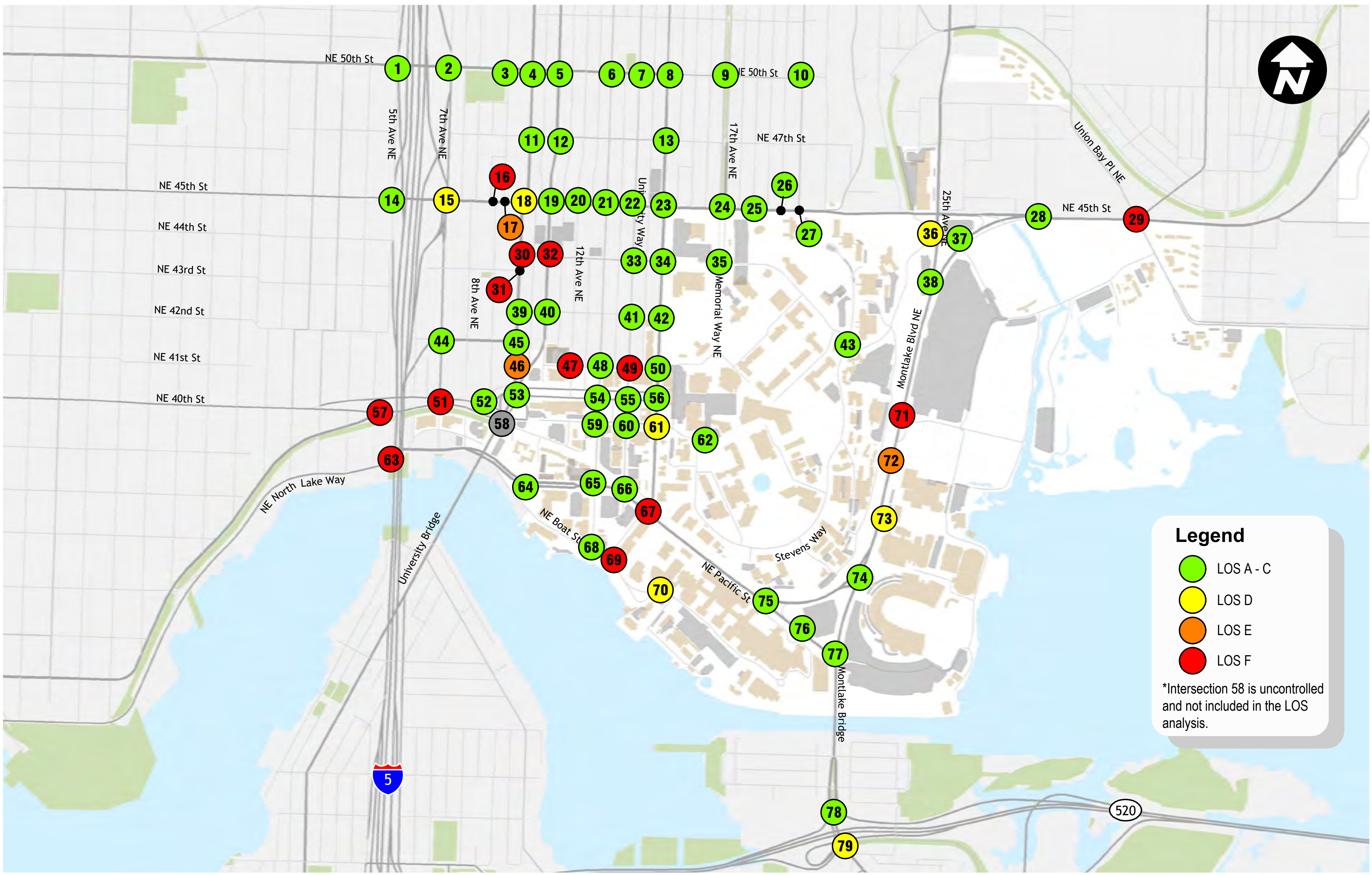
Note: TWSC = Two-way stop-controlled, AWSC = all-way stop-controlled
1. Volume exceeds capacity, and Synchro could not calculate the delay.

Of the stop-controlled intersections listed in Table 7.8, some of the increased delay could be attributed to higher pedestrian and bike volumes with Alternative 3. Additionally, the following intersections are located at or near potential garage access locations, thus resulting in a higher share of alternative percentages:

47. 12th Avenue NE/NE 41st Street
49. University Way NE/NE 41st Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
69. 15th Avenue NE/NE Boat Street
71. Montlake Boulevard NE/Wahkiakum Road
72. Montlake Boulevard NE/IMA exit

The driveway locations would impact the overall trip distribution and individual movements at intersections near these locations. Given the preliminary planning nature of this evaluation, individual traffic impacts should be assessed when final building size and driveway locations are determined. Also, given the gridded network, if drivers were to experience long delays at unsignalized locations, they could alter their trip pattern to reduce delays.

Figure 7.9 shows the weekday PM peak hour traffic operations at study area intersections under Alternative 3. The LOS for vehicle traffic, while a consideration, is increasingly balanced against ensuring that pedestrian, bicycle, and transit travel modes are encouraged and facilitated. Therefore, intersections that are calculated to operate at poor LOS for vehicle traffic are not always considered a high priority for improvements by the City.



Future (2028) Alternative 3 Weekday PM Peak Hour Traffic Operations

FIGURE 7.9

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Intersection Operations – Secondary Impact Zone

Weekday PM peak hour intersection traffic operations under the 2028 No Action Alternative and Alternative 3 conditions are shown in Table 7.9**.** The 2028 geometry for all of the study area intersections were assumed to remain the same as existing conditions. Signal timing splits were optimized under 2028 Alternative 3 conditions. Complete intersection LOS summaries are provided in Appendix C.

Table 7.9
INTERSECTION LEVEL OF SERVICE SUMMARY – SECONDARY IMPACT ZONE

Intersection	No Action		Alternative 3		Change in Delay (sec)
	LOS[1]	Delay[2]	LOS[1]	Delay[2]	
A. Meridian Avenue N/N 45th Street	B	12	B	13	1
B. Meridian Avenue N/N 50th Street	B	17	B	17	0
C. Roosevelt Way NE/NE 65th Street	E	73	F	81	8
D. 12th Avenue NE/NE 65th Street	C	23	C	22	-1
E. 15th Avenue NE/NE 65th Street	F	161	F	160	-1
F. 25th Avenue NE/NE 65th Street	E	80	F	112	32
G. 47th Avenue NE/Sand Point Way NE	D	30	F	59	29

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

As shown in Table 7.9 the secondary impact zone intersections are anticipated to operate at the same LOS under Alternative 3 as they do under the No Action Alternative conditions with the exception of the 25th Avenue NE/ NE 65th Street, 47th Avenue NE/ Sand Point Way NE, and Roosevelt Way NE/ NE 65th Street intersections. The 25th Avenue NE/ NE 65th Street intersection is anticipated to degrade from LOS E to LOS F with approximately a 32 second increase in delay. The 47th Avenue NE/ Sand Point Way NE intersection is anticipated to degrade from LOS D to LOS F with approximately a 29 second increase in delay. The Roosevelt Way NE/ NE 65th Street intersection is anticipated to degrade from LOS E to LOS F with approximately an 8 second increase in delay. Additionally, the 15th Avenue NE/NE 65th Street and 12th Avenue NE/ NE 65th Street intersections are anticipated to experience a slight decrease in delay.

Potential New Access on NE Pacific Street

The impacts of a potential new access along NE Pacific Street, east of 15th Avenue NE at the location of the existing signalized pedestrian crossing, were analyzed for Alternative 3. This potential access, which was analyzed as a signalized intersection, would provide additional access to the approximately 4,000-stall parking garage south of NE Pacific Street that would replace the existing S1 garage. The potential new access point could also be developed to consolidate signals on NE Pacific Street by incorporating the existing pedestrian signal.

For this analysis, vehicle trips to the new parking garage were assumed to be rerouted to allow for the potential new NE Pacific Street access. This access was only analyzed for Alternative 3 because this alternative would include the largest amount of development in South Campus. Table 7.10 shows the differences in intersection operations at locations most affected by the rerouted traffic to the potential new NE Pacific St access.

Table 7.10
INTERSECTION LEVEL OF SERVICE SUMMARY WITH NE PACIFIC STREET ACCESS

Intersection	Alternative 3			Alternative 3 with Potential New Access			Change in Delay (sec)
	LOS[1]	Delay[2]	Project Share	LOS[1]	Delay[2]	Project Share	
67. 15th Avenue NE/NE Pacific Street	F	97	25.5%	E	65	20.5%	-32
69. 15th Avenue NE/NE Boat Street	F	142	36.8%	D	30	19.9%	-112
70. Gate 6 turnaround/ NE Boat Street/NE Columbia Road	D	34	43.4%	C	15	23.5%	-19
80. Possible garage access/NE Pacific Street	-	-	-	B	11	22.1%	11

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

As shown in Table 7.10, an additional access would alleviate delay at intersections immediately affected by traffic to the garage driveways, especially at the 15th Avenue NE/NE Pacific Street, 15th Avenue NE/NE Boat Street, and Gate 6 turnaround/NE Boat Street/NE Columbia Road intersections. Intersection operations at the possible new access would meet LOS standards.

7.5.5 Arterial Operations

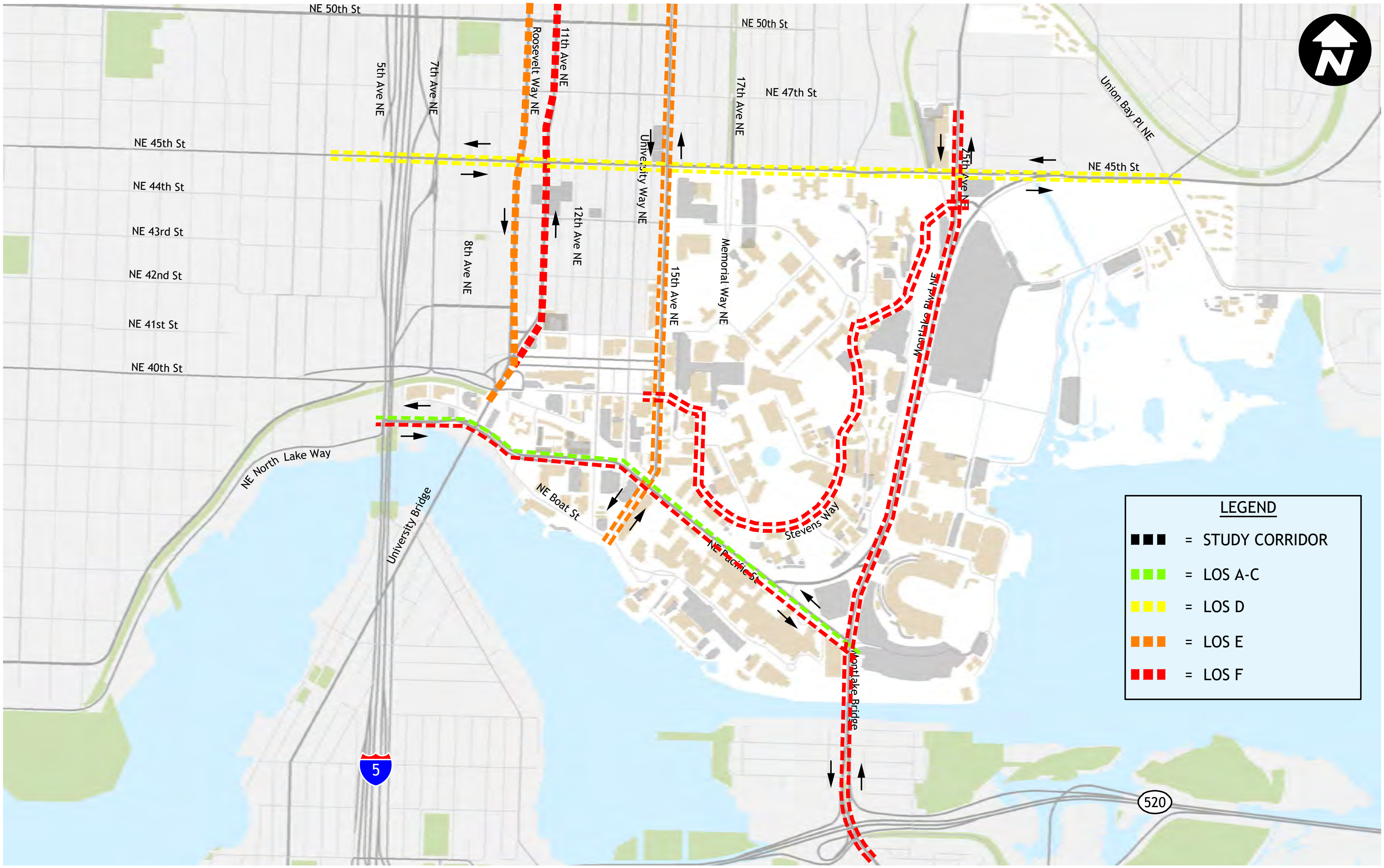
Arterial travel times and speeds were evaluated along NE 45th Street, Pacific Street, 11th Avenue NE, Roosevelt Way NE, 15th Avenue NE, Montlake Boulevard NE, and Stevens Way NE along with traffic data associated with Alternative 3. These data are consistent with the previously described methodology for both existing and future No Action conditions. This includes the application of the adjustment factors previously described. Table 7.11 and Figure 7.10 summarize the weekday PM peak hour No Action and Alternative 3 arterial LOS and travel times and speeds. Detailed arterial operations worksheets are provided in Appendix C.

Table 7.11
WEEKDAY PM PEAK HOUR ARTERIAL LEVEL OF SERVICE AND TRAVEL TIME SUMMARY

Corridor	No Action		Alternative 3	
	LOS[1]	Speed[2]	LOS[1]	Speed[2]
11th Avenue NE between NE Campus Parkway and NE 50th Street				
Northbound	F	5.0	F	3.9
15th Avenue NE between NE Boat Street and NE 50th Street				
Northbound	E	8.0	E	7.1
Southbound	D	9.2	E	7.2
Montlake Boulevard NE between E Lake Washington Boulevard and NE 45th Street				
Northbound	E	11.5	F	10.0
Southbound	F	8.5	F	8.6
NE 45th Street between 5th Avenue NE and Union Bay Place NE				
Eastbound	D	12.0	D	12.0
Westbound	D	11.6	D	10.7
NE Pacific Street (NE Northlake Way) between 6th Avenue NE and Montlake Boulevard E				
Eastbound	C	18.3	F	10.0
Westbound	C	21.9	C	20.6
Roosevelt Way NE between NE Campus Parkway and NE 50th Street				
Southbound	D	10.4	E	8.8
Stevens Way NE between 15th Avenue NE and 25th Avenue NE				
Eastbound	F	3.6	F	3.5
Westbound	F	3.1	F	2.2

1. Level of service.
2. Average speed in miles per hour

As shown in Table 7.11, under Alternative 3, the arterials would generally experience increases in delay and slower travel speeds. LOS is anticipated to degrade as follows: southbound 15th Avenue NE arterial, from LOS D to LOS E; northbound Montlake Boulevard NE, from LOS E to LOS F; eastbound NE Pacific Street, from LOS C to LOS F; and southbound Roosevelt Way NE, from LOS D to LOS E.



Future (2028) Alternative 3 Weekday PM Peak Hour Corridor Traffic Operations

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FIGURE
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7.5.6 Screenline Analysis: Primary Impact Zone

Screenline: An imaginary line across which the number of passing vehicles is counted.

This section describes the analysis completed for two designated screenlines within the study area, consistent with City of Seattle Transportation Concurrency system. Screenlines are imaginary lines across which the number of passing vehicles is counted. In this study, screenlines were selected to count vehicle traffic entering and exiting the University of Washington primary and secondary impact zones. As part of the Mayor's Seattle 2035 Comprehensive Plan (City of Seattle, 2016), two screenlines were identified within the vicinity of the University of Washington, as shown in Figure 7.11. Screenline 5.16 is an east-west screenline, measuring north-south travel, and extends along the Lake Washington Ship Canal to include the University and Montlake bridges. Screenline 13.13 is a north-south screenline, measuring east-west travel, and extends east of Interstate 5 (I-5) between NE Pacific Street and NE Ravenna Boulevard.

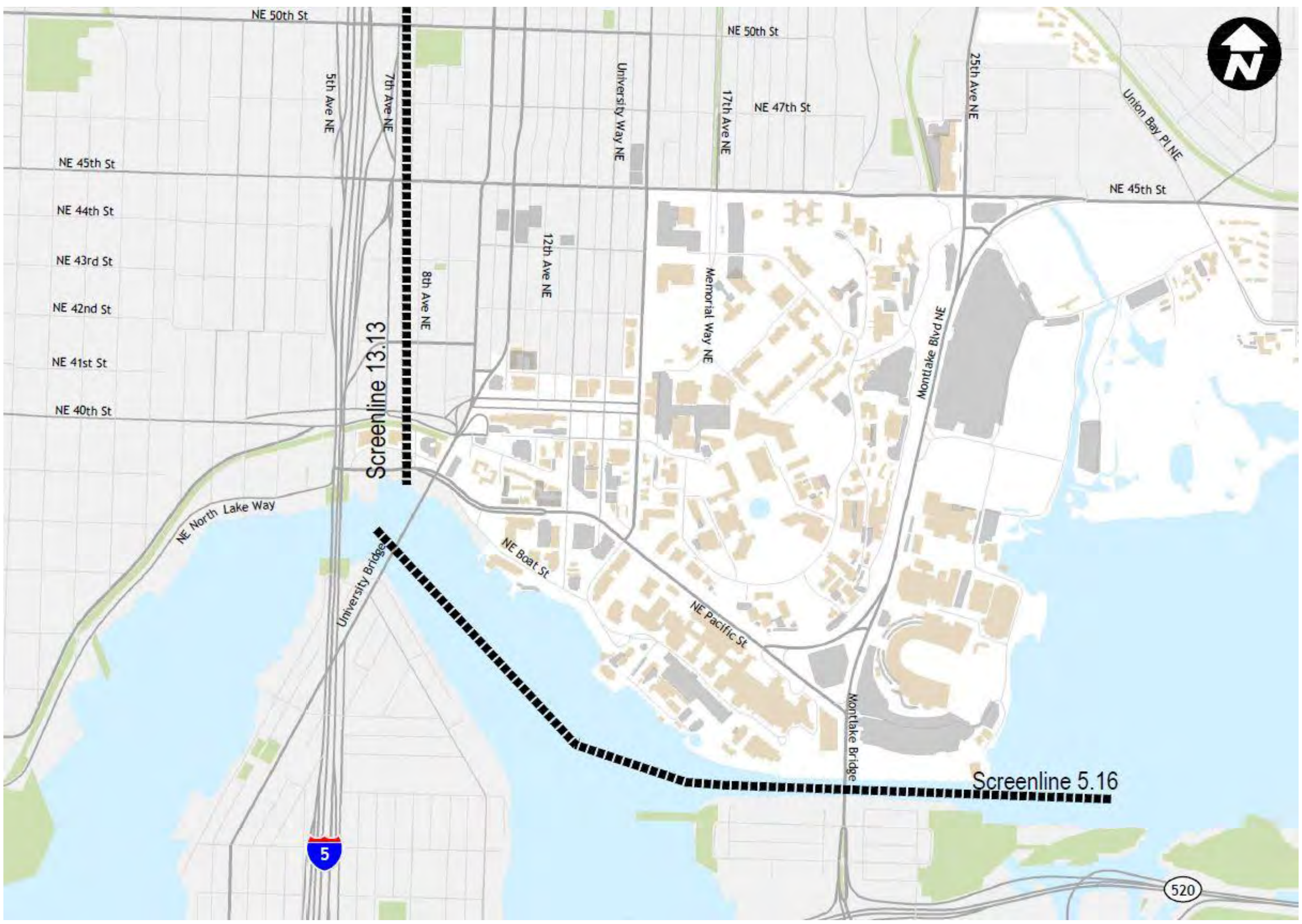


Figure 7.11 Study Area Screenlines

The screenline analysis included volume-to-capacity (V/C) calculations for the vehicles traversing the screenlines using Alternative 3 traffic volumes and interpolated roadway capacity estimates. Roadway capacity for the 2028 horizon year was interpolated using 2016 capacity estimates described in Chapter 3, Affected Environment, and 2035 capacity estimates referenced in the May 2016 Seattle Comprehensive Plan Update Final EIS. Alternative 3 roadway capacity estimates are shown in Table 7.12 below. Detailed screenline volumes and volume to capacity calculations are included in Appendix C.

Table 7.12
ROADWAY CAPACITY AT STUDY AREA SCREENLINES

Screenline	Alternative 3 Capacity
5.16 – Ship Canal, University and Montlake Bridges	
Northbound	4,210
Southbound	4,210
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard	
Eastbound	6,119
Westbound	6,119

Source: Transpo Group, 2016

LOS standards for the screenline analysis were based on the V/C ratio of a screenline. As described in the Seattle Comprehensive Plan Update EIS, the LOS standard V/C ratio for Screenlines 5.16 and 13.13 are 1.20 and 1.00, respectively. For this study, screenline V/C ratios that did not exceed the LOS standard were considered acceptable. A summary of the Alternative 3 screenline analysis is shown in Table 7.13. Detailed screenline analysis calculations are included in Appendix C.

Table 7.13
ALTERNATIVE 3 SCREENLINE ANALYSIS SUMMARY

Screenline	Screenline Volume	Capacity	V/C	LOS Standard V/C
5.16 – Ship Canal, University and Montlake Bridges				
Northbound	4,036	4,210	0.96	1.20
Southbound	4,519	4,210	1.07	1.20
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard				
Eastbound	3,655	6,119	0.60	1.00
Westbound	3,923	6,119	0.64	1.00

Source: NACTO, Seattle Comprehensive Plan Update EIS, and Transpo Group, 2016

As shown in Table 7.13, all Alternative 3 screenline V/C ratios would meet the acceptable LOS standard.

7.5.7 Service/Freight Routes

Impacts would be similar to those identified in Chapter 5 for Alternative 1. No significant impact would result from added freight activity on campus.

7.5.8 Parking

Parking Supply

Similar to the other development alternatives, this analysis assumed that parking supply would be increased or decreased within each campus sector to achieve an 85 percent utilization without exceeding the parking cap for Alternative 3. With Alternative 3, the parking supply cap would be 10,240 spaces for all sectors combined. The location of parking and strategies used to maintain the existing City-University Agreement (CUA) parking cap would be consistent with those outlined for Alternative 1.

Parking Demand

Overall parking demand for Alternative 3 would be the same as with the other development alternatives. Alternative 3 on-campus parking demand and utilization was reviewed by sector to provide context on where parking demand would occur (see Table 7.14). Allocation of Alternative 3 parking demand by sector was based on projected development as documented in Appendix B Methods & Assumptions. The analysis assumes that on-street parking would be allocated to on-campus facilities, given the increases and reallocation of parking supply, to achieve an 85 percent utilization.

Table 7.14
PEAK PARKING DEMAND BY SECTOR

Sector	Parking Supply Cap	Parking Demand			% Utilization
		No Action[1]	Alternative 3		
			Growth[2]	Total	
West	2,900	1,428	1,034	2,462	85%
South	2,020	1,187	533	1,720	85%
East	1,820	1,464	81	1,545	85%
Central	3,500	2,689	290	2,979	85%
Total	**10,240**	**6,768**	**1,938**	**8,706**	**85%**

Source: Transpo Group, 2016

1. On-campus parking demand is based on the projected increase in population. The analysis does not include on-street parking demand increases since these would not be parking within the sectors.
2. The growth in parking demand is based on projected increase in population. The analysis assumed that with the street vacation and reallocation of parking supply in Alternative 3, on-street parking demand would shift to on-campus parking.

As Table 7.14 shows, a reallocation of parking would result in a parking supply under the existing cap and an 85 percent utilization by campus sector as well as the campus as a whole. The additional parking and reallocation of parking supply would provide a better relationship between localized supply and demand and thus reduce the likelihood of parking beyond University of Washington facilities (i.e., within the neighborhoods).

Secondary Parking Impacts

Parking outside the Primary Impact Zone would likely continue with Alternative 3 similar to the No Action Alternative. This would include people parking their vehicles in unrestricted parking within transit-served areas and then using transit to travel to campus. With campus growth, this could occur at higher levels compared to the No Action Alternative.

7.6 AERIAL/STREET VACATIONS

Alternative 3 impacts for the street vacation would be consistent with those described for Alternative 1 in Chapter 5. As noted in Chapter 5, Alternative 1, the City of Seattle has defined polices related to assessing and approving the vacation of public rights-of-way. Further analysis will be provided to the City consistent with the policy requirements when an application for a street vacation is made. The EIS alternatives and supporting analysis reflect the vacation as proposed.

7.7 VEHICLE TRIP CAPS

CUA vehicle trip caps are considered campus-wide and would not materially change between the development alternatives. See the related discussion in Chapter 5, Impacts of Alternative 1.

8 IMPACTS OF ALTERNATIVE 4

This chapter summarizes the results of the analysis conducted for Alternative 4: Campus Development Reflecting Increase West and East Campus Density. As in the previous chapters, the analysis examines the impacts to the key transportation elements and transportation modes identified in Chapter 3, Affected Environment, of this report.

The No Action Alternative, used to compare existing conditions to Alternative 4, assumes a proportion of the development to be 211,000 gross square footage (gsf), as outlined in the City of Seattle adopted 2035 Comprehensive Plan and the adopted U District Rezone.

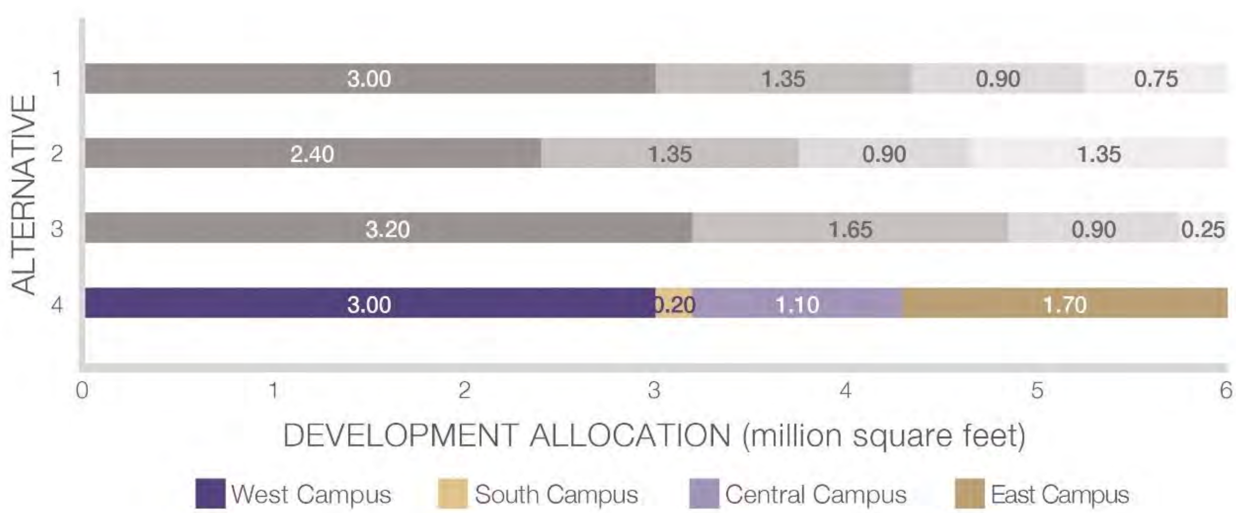
This chapter evaluates all modes of travel and compares **Alternative 4** to the No Action Alternative. Alternative 4 would encompass operations in the horizon year of 2028 with approximately 6 million gross square footage of new development. The focus of those improvements would be primarily in the West and East campus sectors.

8.1 CHANGING CAMPUS CHARACTERISTICS

8.1.1 Description of the Alternative

The proposed University of Washington development under Alternative 4 is anticipated to be primarily located in the West and East campus sectors. The technical analysis of Alternative 4 focuses on the weekday PM peak period.

Alternative 4 would include the development total of 6 million net new square footage of gross floor area (gsf), of which approximately 3 million gsf would be in West Campus and 1.7 million gsf would be located in East Campus. The remaining development would be located in South and Central campus, approximately 200,000 gsf and 1.1 million gsf, respectively, as shown in Figure 8.1.



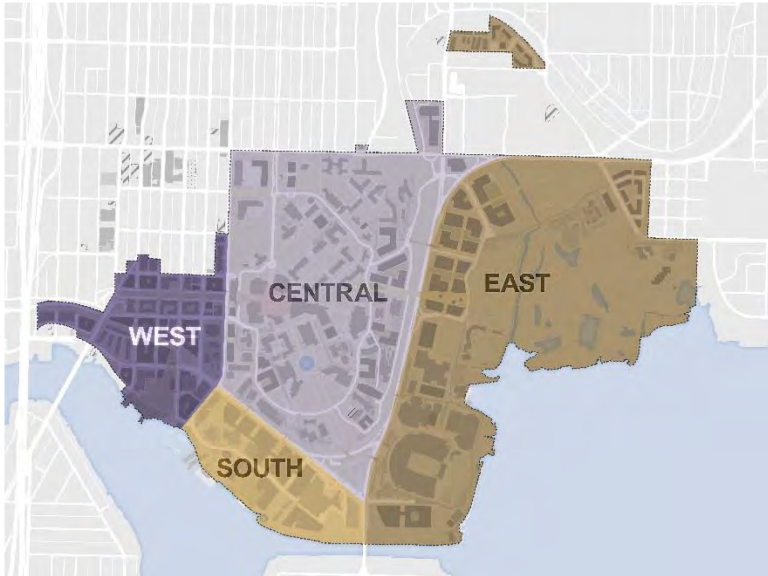


Figure 8.1 Alternative 4 Development Allocation

8.1.2 Trip Generation by Mode

The following provides a summary of the anticipated trip generation for pedestrian, bicycle, transit, and vehicle trips to campus.

The trip generation methodology used for assessing the increase in trips under Alternative 4 is the same as described in Chapter 4, Impacts of No Action. The increase in trips anticipated with Alternative 4 would be similar to other development alternatives and is compared to the No Action Alternative to determine the net increase associated with population growth.

8.2 PEDESTRIANS

8.2.1 Performance Measures

Three pedestrian-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development within 1/4 Mile of Multifamily Housing
- Proportion of Development within 1/4 Mile of University of Washington Residence Halls
- Quality of Pedestrian Environment
- Pedestrian Screenline Demand and Capacity
- Pedestrian Transit Station/Stop Area LOS

These measures reflect the effectiveness of the pedestrian network to provide safe and easy access to pedestrian destinations—specifically housing—and thereby maintain a high walk mode choice on campus. Comparisons of No Action conditions to the development alternatives is provided for each measure below:

Proportion of Development within 1/4 Mile of Multifamily Housing

Walking makes up nearly one-third of all existing campus-related trips to and from campus. Proximity of campus development to housing is therefore an important measure for assessing the propensity of people to walk. This measure assesses the proximity of current campus buildings and development to nearby multifamily housing. As shown in Table 8.1, 80 percent of Alternative 4 development would be within a 1/4 mile of multifamily housing.

Table 8.1
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF MULTIFAMILY HOUSING

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)	Alternative 4 Gross Square Feet (gsf)
West	211,000	3,000,000	3,000,000	3,200,000	3,000,000
South	NA	0	0	0	0
Central	NA	589,985	723,460	0	809,390
East	NA	0 gsf	897,964	645,884	972,832
Total	211,000	3,589,985	4,021,424	3,845,884	4,782,222
Percent	***100%***	***60%***	***67%***	***64%***	***80%***

Proportion of Development within 1/4 Mile of University of Washington Residence Halls

This performance measure assesses the proportion of new development within walking distance of residence halls. University of Washington residence halls were identified and then buffered by 1/4 mile. As shown in Table 8.2, 98 percent of the new development in Alternative 4 would be within 1/4 mile of residence halls.

Table 8.2
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF UNIVERSITY RESIDENCE HALLS

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)	Alternative 4 Gross Square Feet (gsf)
West	211,000	3,000,000	3,000,000	3,200,000	3,000,000
South	NA	249,344	249,344	332,215	200,000
Central	NA	798,357	723,460	788,727	972,747
East	NA	750,000	1,350,000	206,691	1,700,000
Total	211,000	4,797,701	4,722,804	4,527,632	5,872,747
Percent	***100%***	***80%***	***79%***	***76%***	***98%***

Quality of Pedestrian Environment (Primary & Secondary Impact Zones)

Alternative 4 would provide a number of enhancements to pedestrian travel within the Major Institution Overlay (MIO) where development would occur. Improvements in West Campus would mirror those of Alternative 1 with new pedestrian facilities in the waterfront green space and accessible connections to Central Campus. As identified in the Campus Master Plan (CMP), East Campus would have improved pedestrian facilities. South Campus would see little change in the pedestrian environment, maintaining the currently disconnected and impermeable Medical Center. In addition to these upgrades, the City of Seattle's Pedestrian Master Plan highlights new Neighborhood Greenways within the primary and secondary impact zones.

Within the primary impact zone, several greenways are planned in the following locations:

- A southern extension of the existing 12th Avenue NE Neighborhood Greenway
- Walla Walla Road
- NE Boat Street from NE Pacific Street to 15th Avenue NE, which would improve pedestrian connectivity from the Cheshiahud Lake Union Loop to the University of Washington campus
- 20th Avenue NE north of 45th Street and NE 47th Street west of 20th Ave NE, which would increase pedestrian connectivity to the secondary impact zone, and would connect to other planned greenways including 11th Avenue NE, NE 55th Street, and NE 62nd Street
- NE Clark Road

Within the secondary impact zone, greenways in the east section are planned in the following locations:

- 5th Avenue NE
- NE 46th Street
- Keystone Place N
- And in the west section:
- NE Surber Drive
- NE 50th Street

Pedestrian Screenline Capacity

The pedestrian screenline analysis capacity evaluates the peak hour demand, capacity, and level of service (LOS) at all at- and above-grade crossing locations along Montlake Boulevard NE, NE Pacific Street, 15th Avenue NE, and NE 45th Street. The following section summarizes pedestrian screenline volumes in Alternative 4.

Pedestrian Growth from Transit Ridership

Additional growth from increased transit ridership was added to transit stop pedestrian volumes aggregated by screenline, similar to Alternative 1 as described in Chapter 5. This growth accounts for all new pedestrians in the University of Washington study area that would be generated by additional net new transit trips to and from campus.

Pedestrian Growth from Alternative 4 Development

Pedestrian growth from Alternative 4 was assumed to be relative to the No Action Alternative, and evaluated using the same analysis process as Alternative 1 (Chapter 5). Table 8.3 summarizes future Alternative 4 peak hour pedestrian screenline volumes and LOS.

Table 8.3
PEAK HOUR PEDESTRIAN VOLUME AND LEVEL OF SERVICE

Screenline	No Action Alternative		Alternative 4	
	Peak Hour Pedestrian Volume (People/hour)	Level of Service (LOS)	Peak Hour Pedestrian Volume (People/hour)	Level of Service (LOS)
Montlake Boulevard NE	14,770	A	17,588	A
NE Pacific Street	3,744	A	4,524	A
15th Avenue NE	12,078	A	16,684	A
NE 45th Street	2,272	A	2,681	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

As shown in Table 8.3, future Alternative 4 peak hour aggregate pedestrian volumes for all screenlines would be at LOS A.

Pedestrian Transit Stop Space Analysis

This measure evaluates the peak hour demand, capacity, and LOS at key transit stops along Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE. The following sections summarize the pedestrian space per person and LOS at these locations considering Alternative 4 development.

Pedestrian Growth from Transit Ridership

Additional growth from increased transit ridership was added to transit stop pedestrian volumes aggregated by campus sector, similar to Alternative 1 as described in Chapter 5. This growth accounts for all new pedestrians in the University of Washington study area that would be generated by additional net new transit trips to and from campus.

Pedestrian Growth from Alternative 4 Development

Pedestrian space anticipated with Alternative 4 was assumed to be relative to the No Action Alternative, and evaluated using the same method as Alternative 1 (see Chapter 5). Table 8.4 summarizes Alternative 4 peak hour pedestrian space and LOS.

As shown in Table 8.4, Alternative 4 peak hour pedestrian space for all transit stops, with the exception of locations 3 and 5, would be at LOS C or better. Location 3 (mid-block near the 15th Avenue NE/ NE Pacific Street intersection) and location 5 (at the 15th Avenue NE/ NE 42nd Street intersection) would be at LOS F and LOS D, respectively.

Table 8.4
PEAK HOUR PEDESTRIAN VOLUME AND LEVEL OF SERVICE

Stop Location	Stop ID Number	No Action Alternative		Alternative 4	
		Pedestrian Space (ft^2/person)	Level of Service	Pedestrian Space (ft^2/person)	Level of Service
NE Pacific St Bay 1	1	45.0	A	11.3	B
NE Pacific St Bay 2	2	39.0	A	10.9	B
NE Pacific St at 15th Ave NE	3	7.5	C	1.7	F
15th Ave NE at Campus Pkwy	4	62.4	A	8.3	C
15th Ave NE at NE 42nd St	5	50.5	A	6.5	D
15th Ave NE at NE 43rd St	6	27.8	A	7.1	C
Montlake Blvd Bay 4	7	39.0	A	22.3	A
Montlake Blvd Bay 3	8	108.7	A	62.2	A
Stevens Way at Pend Oreille Rd	9	19.0	A	11.9	B
Stevens Way at Benton Ln	10	36.4	A	21.4	A

Source: TCRP Report 165: Transit Capacity & Quality of Service Manual, 3rd Edition.

8.3 BICYCLES

8.3.1 Performance Measures

The following bicycle-related performance measures have been identified to assess and compare alternatives:

- Burke-Gilman Trail Capacity
- Bicycle Parking and Utilization
- Quality of Bicycle Environment

Burke-Gilman Trail Capacity

Alternative 4 would concentrate growth in East and South campus sectors, resulting in the largest growth in pedestrian and bike demand in East Campus among the alternatives. This alternative would likely create the largest change in pedestrian and bicycle travel patterns along the Burke-Gilman Trail because it would diversify uses on East Campus away from surface parking. This alterative would likely increase travel along the eastern segment of the Burke-Gilman Trail between Rainier Vista and Pend Oreille Road. Planned expansion of the Burke-Gilman Trail by separating pedestrian and bicycle uses would provide adequate capacity to meet CMP demands.

LOS results for segments along the Burke-Gilman Trail were based on the Federal Highway Administration's Shared-Use Path Level of Service Calculator (SUPLOS). These results are anticipated to be similar to those presented in Impacts of Alternative 1 (Chapter 5).

Bicycle Parking and Utilization

As described in the Affected Environment chapter, the University has effectively managed bicycle parking demand. As new buildings are constructed, bicycle parking will be provided. For these reasons, additional bicycle parking analysis was not conducted for any of the growth alternatives (Alternatives 1-4).

Quality of Bicycle Environment (Primary and Secondary Impact Zones)

The quality of bicycle facilities and demand anticipated with Alternative 4 would be similar to Alternative 1 in West Campus. In South Campus, limited changes in facilities and demand would be expected. Compared to other alternatives, growth in bicycle travel demand within East Campus would likely be largest under this alternative. Due to the scale of development in East Campus, proximity to the Burke-Gilman Trail, flat terrain, existing bicycle travel patterns, and longer walking distance to transit could result in the largest growth in bicycle travel. In addition to the above-mentioned improvements, the Seattle Bicycle Master Plan includes several proposed improvements within the primary and secondary impact zones.

Within the primary impact zone, planned improvements include:

- A protected bike lane running north/south along Roosevelt Way NE highlights bicycle connectivity improvements (recently installed)
- Protected bike lanes along 11th Avenue NE and 12th Avenue NE
- Protected bike lanes along NE 40th Street, west of Brooklyn Avenue NE that would connect with the existing cycling infrastructure on NE 40th Street, thereby improving connectivity to campus

Within the secondary impact zone, planned improvements include:

- A new protected bike lane along Ravenna Place NE that would provide a direct connection between the Burke-Gillman Trail and Ravenna Park
- A protected bike lane along 36th Avenue NE that would increase bicycle connectivity in the north/south directions

A planned Neighborhood Greenway along Fairview Avenue E that would increase the cycle connection to campus from the south.

8.4 TRANSIT

8.4.1 Performance Measures

The following transit-related performance measures have been identified to assess and compare alternatives:

- Proportion of Development within 1/4 Mile of RapidRide
- Proportion of development within 1/2 Mile of Light Rail
- Transit Stop Capacity
- Transit Travel Times and Delay
- Transit Loads at Screenlines

Proportion of Development within 1/4 Mile of RapidRide

This measure calculates the proportion of development within 1/4 mile of RapidRide service to the University of Washington. As shown in Table 8.5 below, 100 percent of the new development would be within a 1/4-mile proximity of RapidRide.

Table 8.5
PROPORTION OF DEVELOPMENT WITHIN 1/4 MILE OF RAPIDRIDE

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)	Alternative 4 Gross Square Feet (gsf)
West	211,000	3,000,000	2,400,000	3,200,000	3,000,000
South	NA	1,350,000	1,350,000	1,650,000	200,000
Central	NA	900,000	900,000	900,000	1,100,000
East	NA	750,000	1,350,000	250,000	1,700,000
Total	**211,000**	**6,000,000**	**6,000,000**	**6,000,000**	**6,000,000**
Percent	***100%***	***100%***	***100%***	***100%***	***100%***

Proportion of Development within 1/2 Mile of Light Rail

This measure calculates the proportion of development within a 1/2-mile walkshed of light rail stations. This action includes the U District Station at Brooklyn Street between NE 45th and NE 43rd streets, assumed to be completed in 2021. Table 8.6 summarizes the square footage of development within a 1/2-mile walkshed of light rail in No Action, Alternative 1, Alternative 2, Alternative 3, and Alternative 4. Similar to Alternative 2, Alternative 4 would concentrate more development in East Campus outside of the 1/2-mile walkshed, which would result in a lower overall coverage.

Table 8.6
PROPORTION OF DEVELOPMENT WITHIN 1/2 MILE OF LIGHT RAIL

Sector	No Action Gross Square Feet (gsf)	Alternative 1 Gross Square Feet (gsf)	Alternative 2 Gross Square Feet (gsf)	Alternative 3 Gross Square Feet (gsf)	Alternative 4 Gross Square Feet (gsf)
West	211,000	2,680,232	2,160,729	2,880,973	2,680,232
South	NA	1,350,000	1,350,000	1,650,000	200,000
Central	NA	900,000	900,000	900,000	1,100,000
East	NA	750,000	452,036	250,000	727,168
Total	**211,000**	**5,680,232**	**4,862,766**	**5,680,973**	**4,707,400**
Percent	***100%***	***89%***	***90%***	***90%***	***89%***

Transit Stop Capacity

This measure evaluates the number of buses that a transit stop can process in an hour. This analysis was performed for four pairs of stops on key transit corridors around the University of Washington: 15th Avenue NE, NE 45th Street, Montlake Boulevard and NE Pacific Street. The transit stop capacity and demand do not change by alternative. Therefore, the summary provided in Chapter 4, Impacts of No Action, Alternative reflects the expected operations.

Transit Travel Times and Delay

Transit travel speeds do not vary between development alternatives. Therefore, the transit corridor speeds are the same as Alternative 1 (Chapter 5).

Transit Loads at Screenlines

See Chapter 5, Impacts of Alternative 1.

8.5 VEHICLE

8.5.1 Performance Measures

Six measures of effectiveness were analyzed to evaluate the impact of the campus growth on the surrounding transportation network:

- Intersection operational level of service for intersection located in the primary and secondary impact area
- Arterial Corridor Operations
- Screenline Volumes
- Cordon Volumes
- Caps are set as 1990 trip levels to the University District and University (MIO)
- Freight Corridor Impact

8.5.2 Traffic Volumes

Increased vehicle traffic associated with Alternative 4 was assigned to potential garage locations based on existing vehicle travel patterns, previous studies in the project vicinity, review of University information, and U.S. Census Bureau's *OnTheMap* tool. *OnTheMap* is a web-based mapping and reporting application that shows where workers are employed and where they live based on census data. The ZIP codes within the data were evaluated to determine if a person would be more likely to travel from the ZIP code via vehicle or by other means. Individuals making trips to ZIP codes closer to the proposed project sites or in more transit-oriented locations are more likely to use transit, walk, bicycle, or other non-drive alone modes. Individuals making trips to ZIP codes outside the Seattle city limits and/or farther from the site are more likely to drive. The general trip distribution to/from the University of Washington is shown in Chapter 4, Impacts of No Action.

Primary Impact Zone

Project trips for each potential garage location were assigned to the study intersections based on the general trip distribution patterns shown in Chapter 4. Project trips at each intersection are shown on Figure 8.2 and Figure 8.3 below. The resulting Alternative 4 volumes are shown in Figure 8.4 and Figure 8.5.

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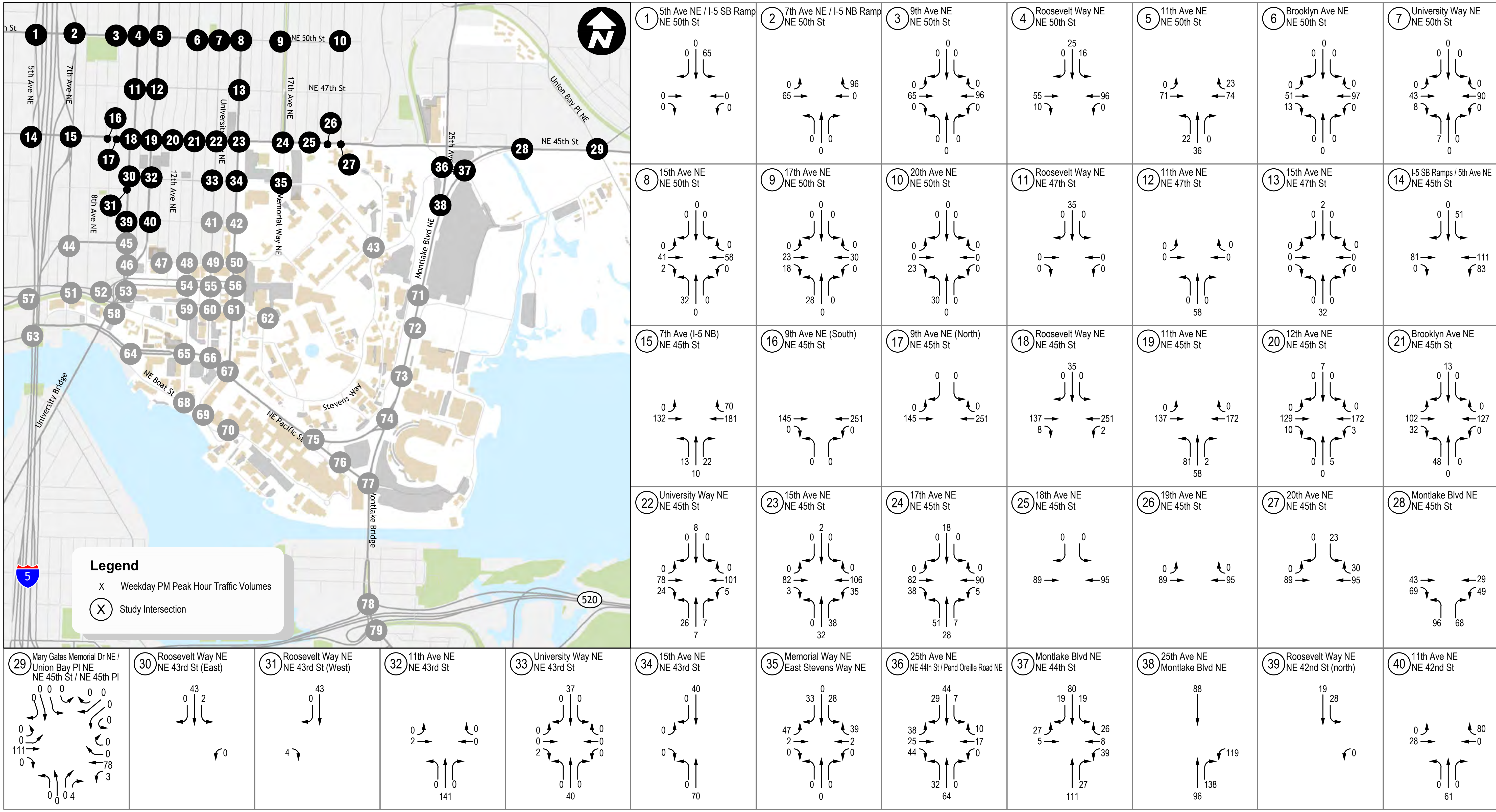
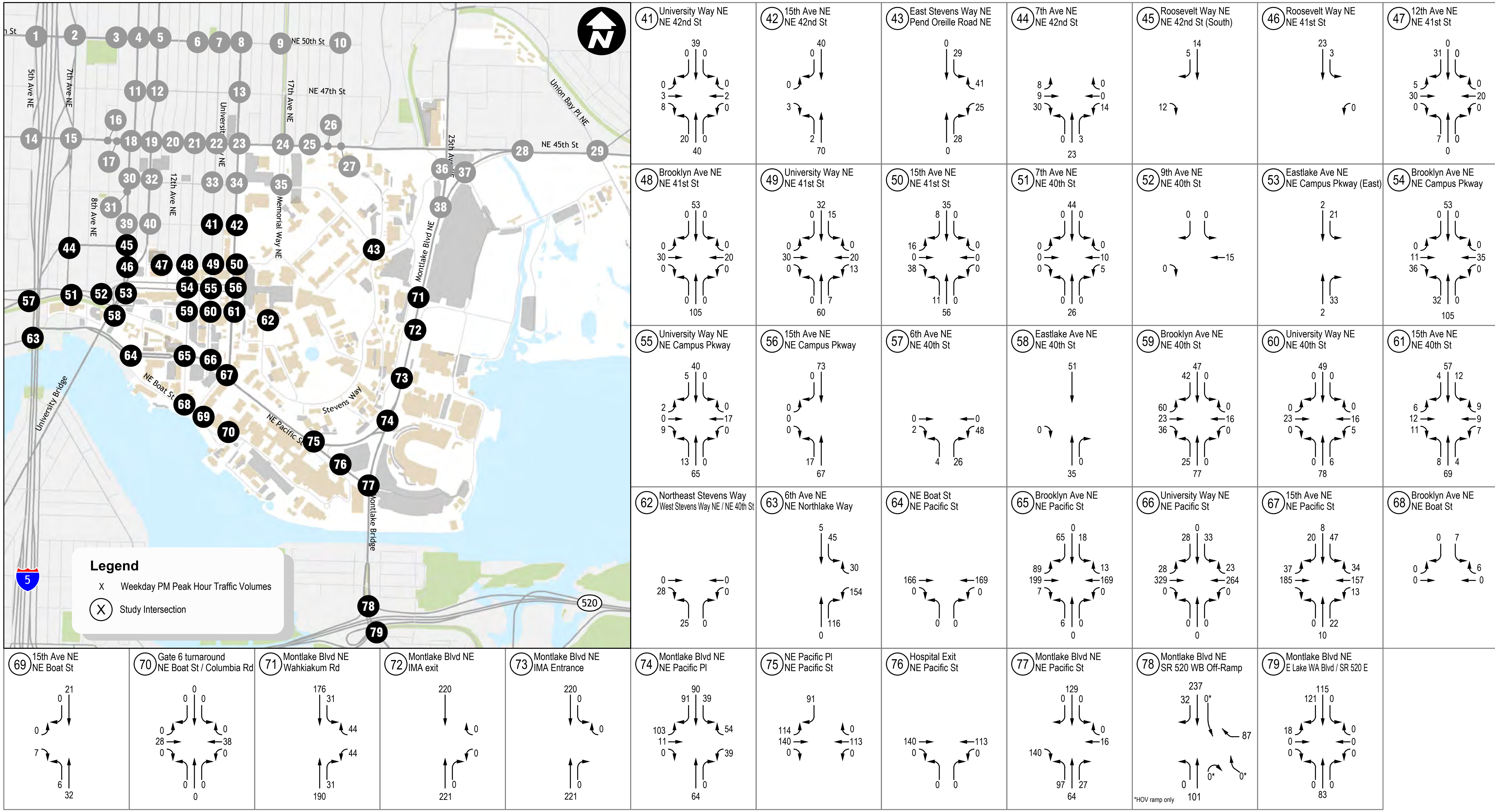


Future (2028) Alternative 4 (Intersections 1-40) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE 8.2

transpogroup WHAT TRANSPORTATION CAN BE.

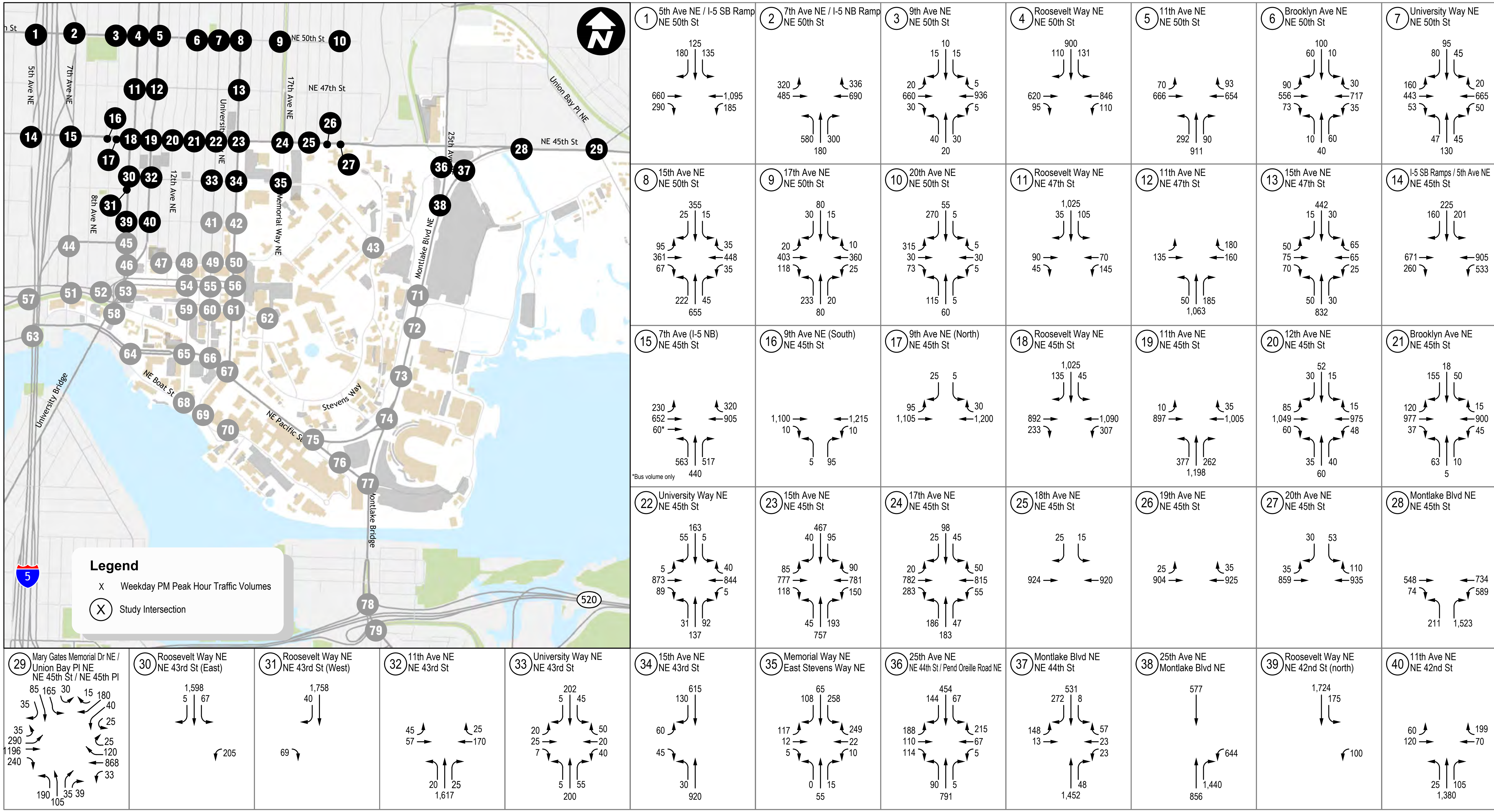


Future (2028) Alternative 4 (Intersections 41-79) Project Trips

University of Washington 2018 Campus Master Plan

FIGURE **8.3**

transpogroup WHAT TRANSPORTATION CAN BE.



Future (2028) Alternative 4 (Intersections 1-40) Weekday PM Peak Hour Traffic Volumes

FIGURE 8.4

University of Washington 2018 Campus Master Plan

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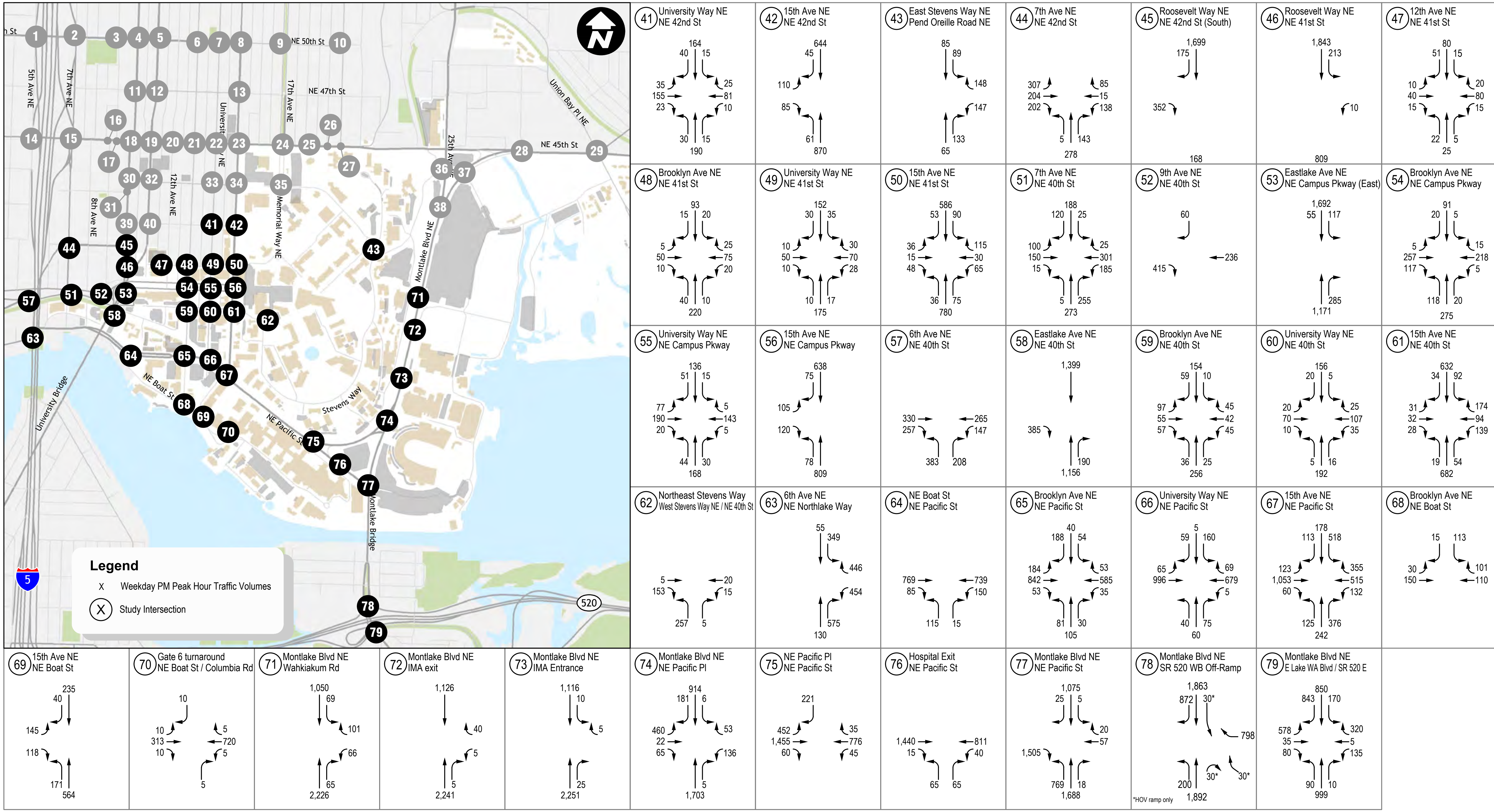


Future (2028) Alternative 4 (Intersections 41-79) Weekday PM Peak Hour Traffic Volumes

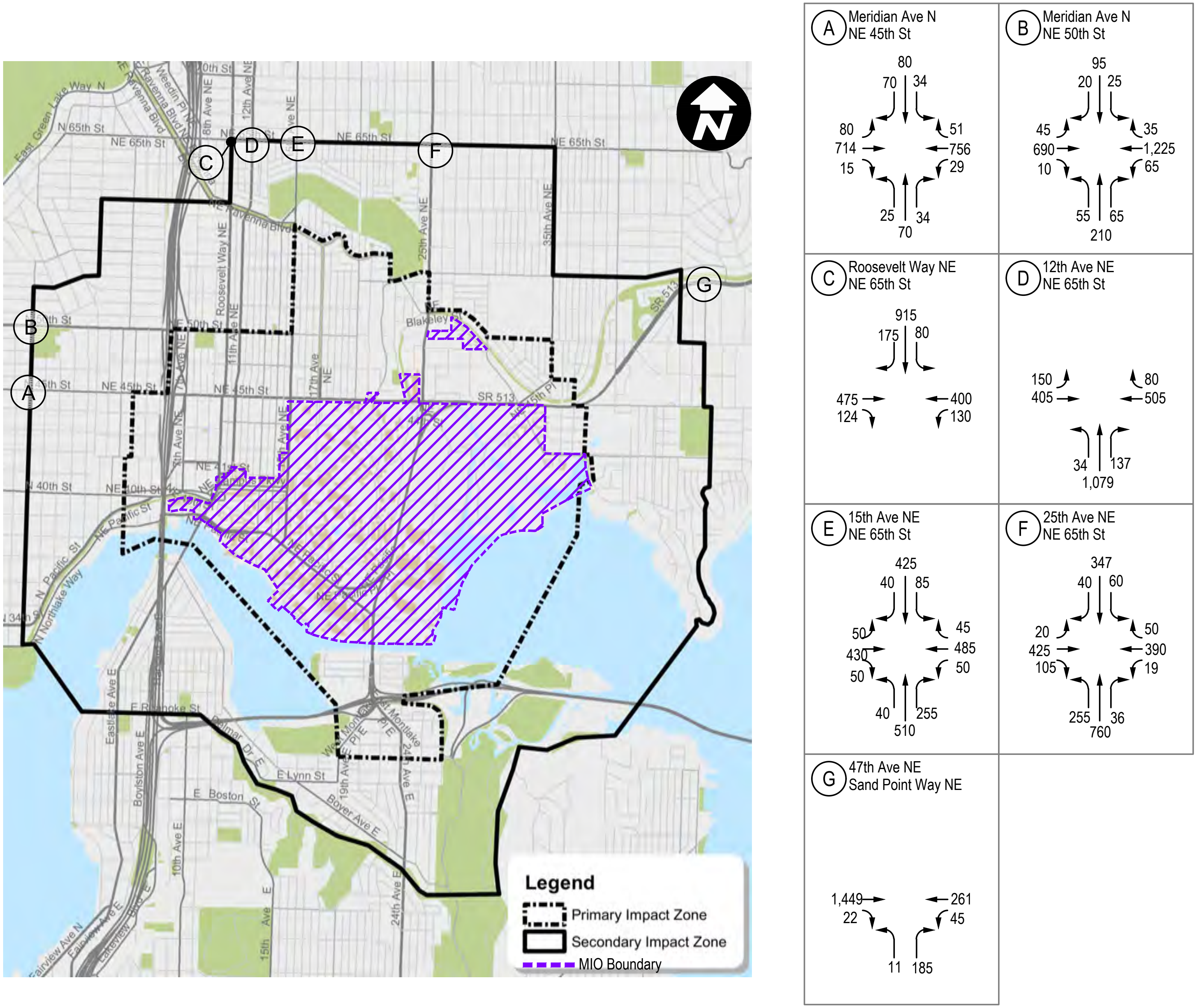
University of Washington 2018 Campus Master Plan

FIGURE
8.5

transpogroup
WHAT TRANSPORTATION CAN BE.

Secondary Impact Zone

Weekday PM peak hour volumes at seven intersections in the secondary impact zone were analyzed by considering future background traffic and volumes associated with the Alternative 4 development. Alternative 4 directional volumes were forecast in the same manner as all primary impact zone study intersections as described above. It was assumed that 5 percent of future volumes would be distributed into the neighborhood roadway network and therefore would not travel through the secondary impact zone study intersections. The resulting secondary impact zone volumes are shown in Figure 8.6.



Alternative 4 Secondary Impact Zone Weekday PM Peak Hour Volumes

FIGURE 8.6

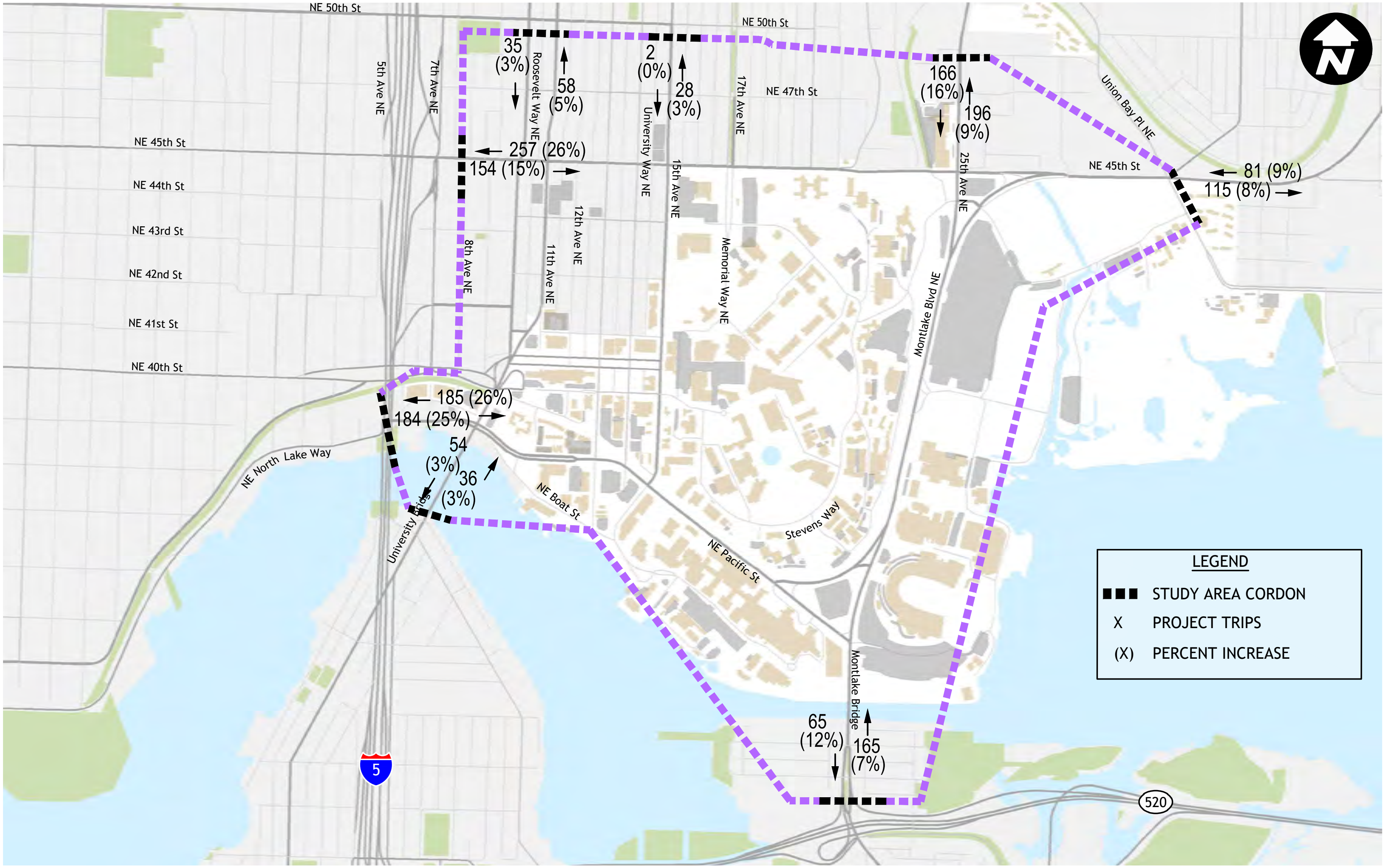
University of Washington 2018 Campus Master Plan

transpogroup WHAT TRANSPORTATION CAN BE.

8.5.1 Cordon Volume Analysis

> **Cordon:** An imaginary line used to evaluate traffic in and out of the University area and measure the change or increase in traffic associated with the proposed alternatives.

To understand the volumes considered under the different alternative scenarios, a cordon volume analysis was completed. The cordon volume analysis focused on the major roadways leading to and from the University. The cordon volume analysis also showed the percentage of total trips along the corridor that were associated with the increased traffic generated by Alternative 4. The cordon volume and project share associated with Alternative 4 are shown in Figure 8.7. Note that these data reflect the percentage increase associated with continued development on-campus. As shown in the figure, project-related volumes would increase cordon volumes by 10–11 percent. Similar to Alternative 1, this increase could be constrained by the available arterial street capacity.



Future (2028) Alternative 4 PM Peak Hour Cordon Volumes and Proportional Increase

University of Washington 2018 Campus Master Plan

FIGURE **8.7**

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8.5.2 Traffic Operations Performance

Methodology

The methodology used in assessing intersection and corridor LOS is consistent with that described for the Affected Environment (Chapter 3) and No Action Alternative (Chapter 4) scenarios. A detailed description of the methodology used can be found in Appendix B: Methods and Assumptions.

Intersection Operations – Primary Impact Zone

Weekday PM peak hour intersection traffic operations during the Alternative 4 conditions are summarized in Figure 8.8 and

Figure 8.9. The year 2028 geometry for all of the study-area intersections was assumed to remain the same as No Action Alternative conditions except when modifications are expected as part of the alternative. Additionally, signal timing splits and offsets were optimized under Alternative 4. Complete intersection LOS summaries are provided in Appendix C.

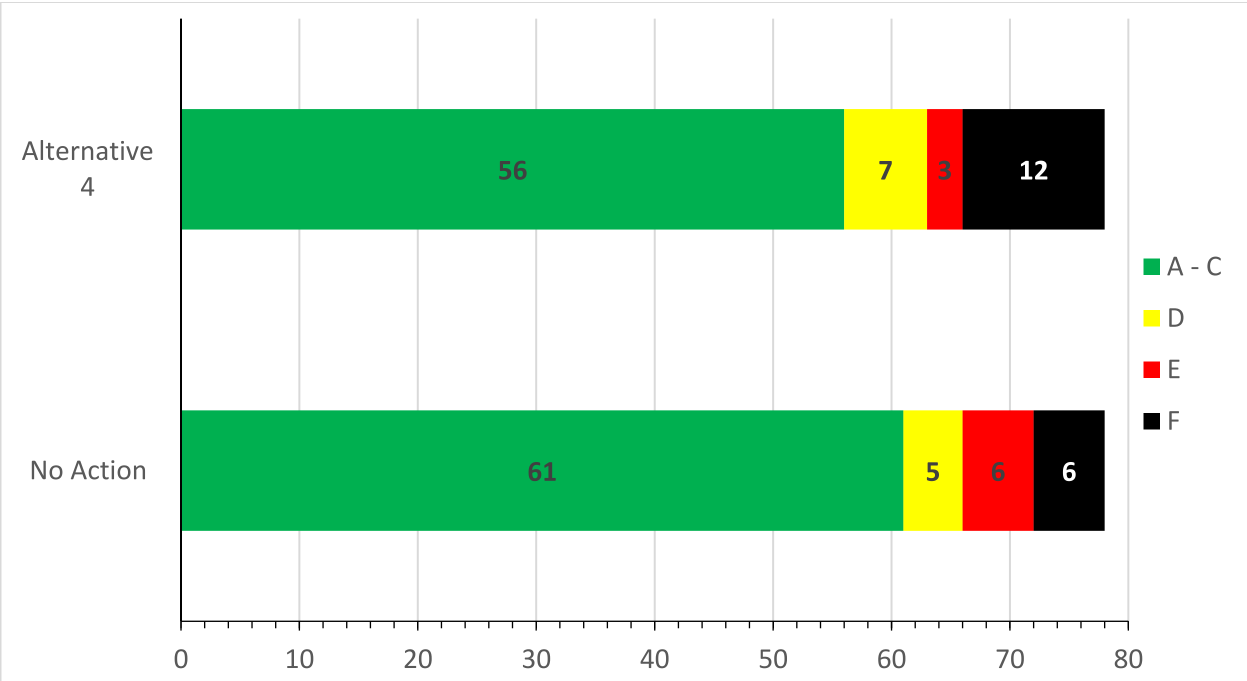
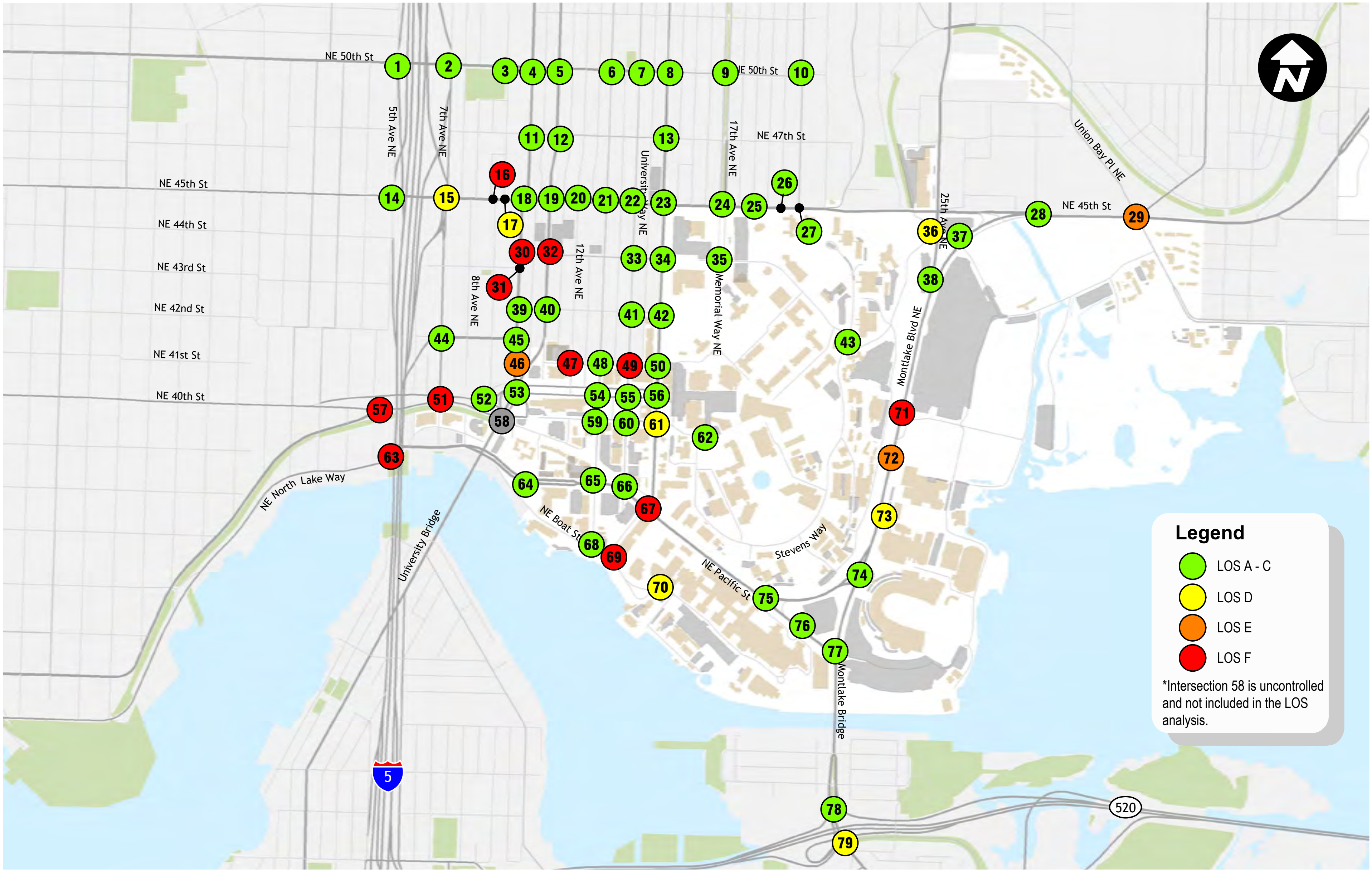


Figure 8.8 Weekday PM Intersection Level of Service Summary



Future (2028) Alternative 4 Weekday PM Peak Hour Traffic Operations

FIGURE 8.9

University of Washington 2018 Campus Master Plan

transpogroup WHAT TRANSPORTATION CAN BE.

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Table 8.7 illustrates changes in intersection traffic operations at intersections anticipated to operate at LOS E or F during the weekday PM peak hour under Alternative 4 conditions.

Table 8.7
INTERSECTION LEVEL OF SERVICE PM PEAK HOUR SUMMARY

Intersection	No Action		Alternative 4		Change in Delay (sec)	Project Share
	LOS[1]	Delay[2]	LOS[1]	Delay[2]		
16. 9th Ave NE (South) / NE 45th St	E	41	F	68	27	16.4%
29. Montlake Blvd NE / Mary Gates Memorial Dr NE	D	50	E	56	6	5.2%
30. Roosevelt Way NE / NE 43rd St (East)	F	793	F	950	157	2.4%
31. Roosevelt Way NE / NE 43rd St (West)	F	74	F	111	67	2.5%
32. 11th Ave NE/ NE 43rd St	E	72	F	105	33	7.4%
46. Roosevelt Way NE / NE 41st St	E	36	E	39	3	1.3%
47. 12th Ave NE / NE 41st St	F	52	F	664	612	24.6%
49. University Way NE / NE 41st St	F	*	F	*	*	28.7%
51. 7th Ave NE / NE 40th St	E	44	F	61	17	6.5%
57. 6th Ave NE / NE 40th St	F	107	F	136	29	6.3%
63. 6th Ave NE / NE Northlake Way	E	38	F	110	72	18.6%
67. 15th Ave NE / NE Pacific St	D	37	F	99	62	25.5%
69. 15th Ave NE/NE Boat St	C	18	F	142	124	36.8%
71. Montlake Blvd NE / Wahkiakum Rd	F	343	F	3,022	2679	9.1%
72. Montlake Blvd NE / IMA exit	D	34	E	42	8	9.3%

*Volume exceeds capacity and Synchro could not calculate the delay.

1. Level of service. 2. Average delay per vehicle in seconds rounded to the whole second.

During the weekday PM peak hour, six additional intersections are anticipated to operate at LOS F under Alternative 4 traffic conditions compared to the No Action Alternative conditions. Overall, 22 intersections are anticipated to operate at LOS D or worse during the weekday PM peak hour with Alternative 4, as compared to 17 under No Action conditions. The City of Seattle does not have an LOS standard but generally considers LOS E and LOS F at signalized intersections and LOS F at unsignalized intersections to reflect poor operations. Intersections that degrade from LOS D to E or operate at LOS E or LOS F under the "with-project" condition, or increase by more than 5 seconds, could be considered significant by the City.

The following intersections are anticipated to degrade to LOS D or worse under Alternative 4 conditions:

16. 9th Avenue NE (South)/NE 45th Street
17. 9th Avenue NE (North)/NE 45th Street
29. Montlake Boulevard NE/Mary Gates Memorial Drive NE
32. 11th Avenue NE/NE 43rd Street
51. 7th Avenue NE/NE 40th Street
61. 15th Avenue NE/NE 40th Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
69. 15th Avenue NE/NE Boat Street
70. Gate 6 turnaround/NE Boat Street/Columbia Road
72. Montlake Boulevard NE/IMA exit
73. Montlake Boulevard NE/IMA entrance

Intersections where the LOS would be E or F and where the Alternative 1 traffic would increase delay by more than 5 seconds are shown in Table 8.8. A majority of the intersections is unsignalized. At the two-way stop controlled (TWSC) intersections, the change in delay is represented for the worst movement.

Table 8.8
INTERSECTION OPERATIONS POTENTIAL IMPACTS SUMMARY

Intersection	Traffic Control	Change in Delay (Seconds)	Percent of Total (Project Share)
16. 9th Avenue NE (South)/NE 45th Street	TWSC	27	16.4%
29. Montlake Boulevard NE/Mary Gates Memorial Drive NE	Signalized	6	5.2%
30. Roosevelt Way NE/NE 43rd Street (East)	TWSC	157	2.4%
31. Roosevelt Way NE/NE 43rd Street (West)	TWSC	37	2.5%
32. 11th Avenue NE/NE 43rd Street	Signalized	34	7.4%
47. 12th Avenue NE/NE 41st Street	TWSC	612	24.6%
49. University Way NE/NE 41st Street	TWSC	-[1]	28.7%
51. 7th Avenue NE / NE 40th Street	AWSC	17	6.5%
57. 6th Avenue NE / NE 40th Street	AWSC	29	6.3%
63. 6th Avenue NE / NE Northlake Way	AWSC	72	18.6%
67. 15th Avenue NE / NE Pacific Street	Signalized	61	25.5%
69. 15th Avenue NE/NE Boat Street	AWSC	124	36.8%
71. Montlake Boulevard NE / Wahkiakum Road	TWSC	2679	9.1%
72. Montlake Boulevard NE / IMA exit	TWSC	8	9.36%

Note: TWSC = two-way stop controlled, AWSC = all-way stop controlled
1. Volume exceeds capacity and Synchro could not calculate the delay.

Of the stop controlled intersections listed in Table 8.8, some of the increased delay can be attributed to the higher pedestrian and bicycle volumes. Additionally, the following intersections are located at or near potential garage access locations resulting in higher project share percentages:

47. 12th Avenue NE/NE 41st Street
49. University Way NE/NE 41st Street
63. 6th Avenue NE/NE Northlake Way
67. 15th Avenue NE/NE Pacific Street
71. Montlake Boulevard NE / Wahkiakum Road
72. Montlake Boulevard NE/IMA exit

Driveways and building access features to be incorporated into planned development can have impacts on the overall trip distribution and individual movements at intersections near these locations. Given the preliminary planning nature of this evaluation, individual traffic impacts should be assessed when final building size and driveway locations are determined. Also, given the grid network, if drivers were to experience long delays at unsignalized locations, they could alter their trip patterns to reduce delays. It is also recognized that LOS for vehicle traffic, while a consideration, must be increasingly balanced against the assumption that pedestrian, bicycle, and transit travel modes would be encouraged and facilitated. Intersections that are calculated to operate at poor LOS for vehicle traffic are not always considered a high priority for improvement by the City.

Intersection Operations – Secondary Impact Zone

Weekday PM peak hour intersection traffic operations under the 2028 No Action Alternative and Alternative 4 conditions are shown in Table 8.9. The 2028 geometry for all of the study area intersections were assumed to remain the same as existing conditions. Signal timing splits were optimized under 2028 Alternative 4 conditions. Complete intersection LOS summaries are provided in Appendix C.

Table 8.9
INTERSECTION LEVEL OF SERVICE SUMMARY – SECONDARY IMPACT ZONE

Intersection	No Action		Alternative 4		Change in Delay (sec)
	LOS[1]	Delay[2]	LOS[1]	Delay[2]	
A. Meridian Avenue N/N 45th Street	B	12	B	13	1
B. Meridian Avenue N/N 50th Street	B	17	B	17	0
C. Roosevelt Way NE/NE 65th Street	E	73	F	81	8
D. 12th Avenue NE/NE 65th Street	C	23	C	22	-1
E. 15th Avenue NE/NE 65th Street	F	161	F	160	-1
F. 25th Avenue NE/NE 65th Street	E	80	F	111	31
G. 47th Avenue NE/Sand Point Way NE	D	30	F	59	29

1. Level of service.
2. Average delay per vehicle in seconds rounded to the whole second.

As shown in Table 8.9 the secondary impact zone intersections are anticipated to operate at the same LOS under Alternative 4 as they do under the No Action Alternative conditions with the exception of the 25th

Avenue NE/ NE 65th Street, 47th Avenue NE/ Sand Point Way NE, and Roosevelt Way NE/ NE 65th Street intersections. The 25th Avenue NE/ NE 65th Street intersection is anticipated to degrade from LOS E to LOS F with approximately a 31 second increase in delay. The 47th Avenue NE/ Sand Point Way NE intersection is anticipated to degrade from LOS D to LOS F with approximately a 29 second increase in delay. The Roosevelt Way NE/ NE 65th Street intersection is anticipated to degrade from LOS E to LOS F with approximately an 8 second increase in delay. Additionally, the 15th Avenue NE/NE 65th Street and 12th Avenue NE/ NE 65th Street intersections are anticipated to experience a slight decrease in delay.

8.5.3 Arterial Operations

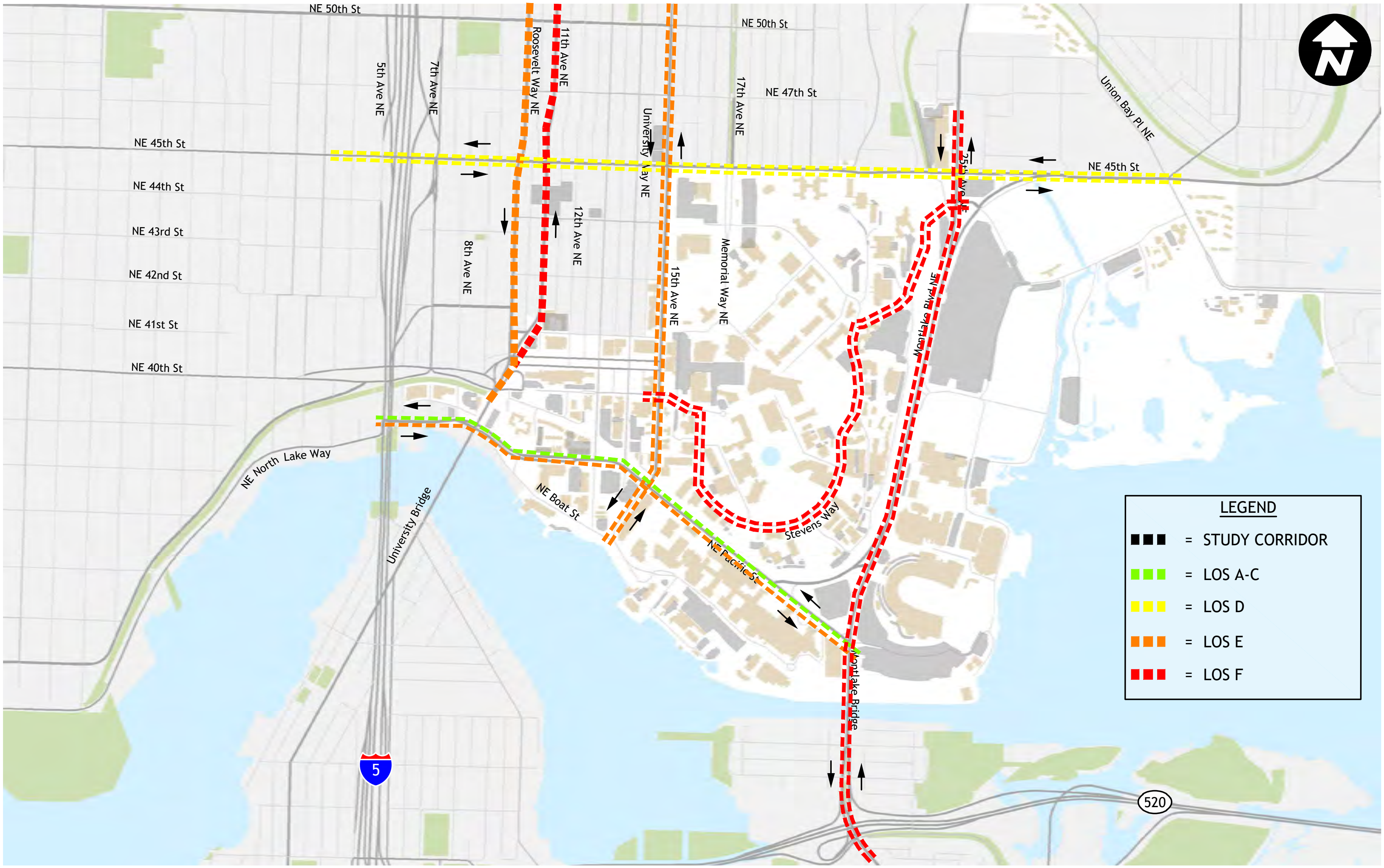
Arterial travel times and speeds were evaluated along NE 45th Street, Pacific Street, 11th Avenue NE, Roosevelt Way NE, 15th Avenue NE, Montlake Boulevard NE, and Stevens Way NE, along with traffic data associated with Alternative 4. These data are consistent with the previously described methodology for No Action conditions. This includes the application of the adjustment factors previously described. Table 8.10 and Figure 8.10 summarize weekday PM peak hour arterial travel times and speeds. Detailed arterial operations worksheets are provided in Appendix C.

Table 8.10
WEEKDAY PM PEAK HOUR ARTERIAL LEVEL OF SERVICE AND TRAVEL TIME SUMMARY

Corridor	No Action		Alternative 4	
	LOS[1]	Speed[2]	LOS[1]	Speed[2]
11th Avenue NE between NE Campus Parkway and NE 50th Street				
Northbound	F	5.0	F	4.0
15th Avenue NE between NE Boat Street and NE 50th Street				
Northbound	E	8.0	E	7.5
Southbound	D	9.2	F	6.8
Montlake Boulevard NE between E Lake Washington Boulevard and NE 45th Street				
Northbound	E	11.5	F	10.0
Southbound	F	8.5	F	8.7
NE 45th Street between 5th Avenue NE and Union Bay Place NE				
Eastbound	D	12.0	D	11.3
Westbound	D	11.6	D	10.8
NE Pacific Street (NE Northlake Way) between 6th Avenue NE and Montlake Boulevard E				
Eastbound	C	18.3	E	11.9
Westbound	C	21.9	C	20.8
Roosevelt Way NE between NE Campus Parkway and NE 50th Street				
Southbound	D	10.4	E	8.9
Stevens Way NE between 15th Avenue NE and 25th Avenue NE				
Eastbound	F	3.6	F	3.3
Westbound	F	3.1	F	2.4

1. Level of service.
2. Average speed in miles per hour

As shown in Table 8.10, with Alternative 4 the arterials would generally experience increases in delay and slower travel speeds. Anticipated LOS expected is as follows: Southbound 15th Avenue NE (from LOS D to LOS F), northbound Montlake Boulevard NE (from LOS E to LOS F), eastbound NE Pacific Street (from LOS C to LOS E), and southbound Roosevelt Way NE (from LOS D to LOS E).



Future (2028) Alternative 4 Weekday PM Peak Hour Corridor Traffic Operations

FIGURE 8.10

University of Washington 2018 Campus Master Plan

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8.5.4 Screenline Analysis: Primary Impact Zone

> **Screenline:** An imaginary line across which the number of passing vehicles is counted.

This section describes the analysis completed for two designated screenlines within the study area, consistent with the City of Seattle Transportation Concurrency system. Screenlines are imaginary lines across which the number of passing vehicles is counted. In this study, screenlines were selected to count vehicle traffic entering and exiting the University of Washington primary and secondary impact zones. As part of the Mayor's Seattle 2035 Comprehensive Plan (City of Seattle, 2016), two screenlines were identified within the vicinity of the University of Washington, as shown in Figure 8.11. Screenline 5.16 is an east-west screenline, measuring north-south travel, and extending along the Lake Washington Ship Canal to include the University and Montlake bridges. Screenline 13.13 is a north-south screenline, measuring east-west travel, and extending east of Interstate 5 (I-5) between NE Pacific Street and NE Ravenna Boulevard.

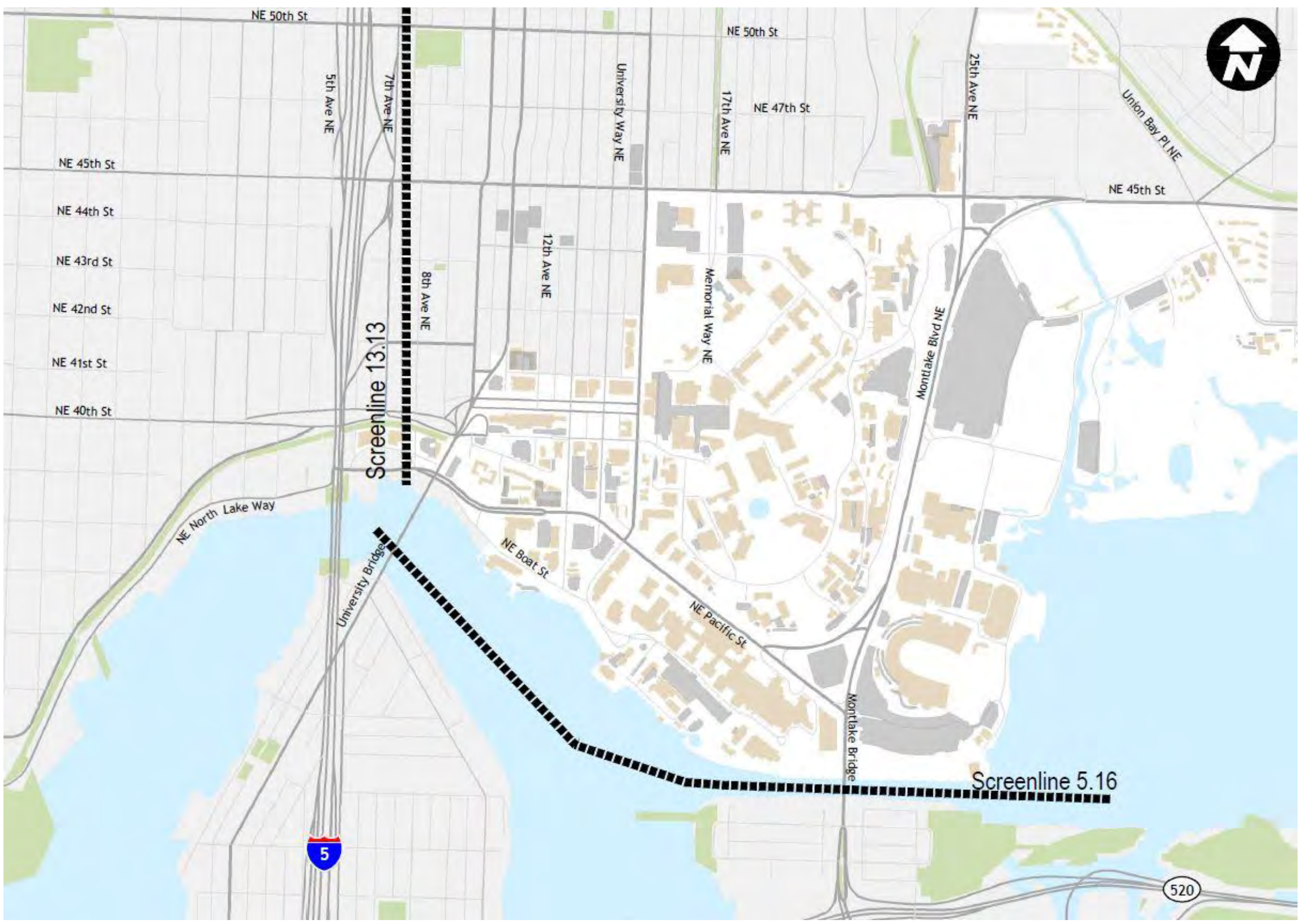

Figure 8.11 Study Area Screenlines

The screenline analysis included volume-to-capacity (V/C) calculations for the vehicles traversing the screenlines using Alternative 4 traffic volumes and interpolated roadway capacity estimates. Roadway capacity for the 2028 future horizon year was interpolated using 2016 capacity estimates described in Chapter 3, Affected Environment, and 2035 capacity estimates referenced in the May 2016 Seattle Comprehensive Plan Update Final EIS. Alternative 4 roadway capacity estimates are shown in Table 8.11 below. Detailed screenline volumes and V/C calculations are included in Appendix C.

Table 8.11
ROADWAY CAPACITY AT STUDY AREA SCREENLINES

Screenline	Alternative 4 Capacity
5.16 – Ship Canal, University and Montlake Bridges	
Northbound	4,210
Southbound	4,210
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard	
Eastbound	6,119
Westbound	6,119

Source: Transpo Group, 2016

LOS standards for the screenline analysis were based on the V/C ratio of a screenline. As described in the Seattle Comprehensive Plan Update EIS, the LOS standard V/C ratio for Screenline 5.16 and Screenline 13.13 were 1.20 and 1.00, respectively. For this study, screenline V/C ratios that did not exceed the LOS standard were considered acceptable. A summary of the Alternative 4 screenline analysis is shown in Table 8.12. Detailed screenline analysis calculations are included in Appendix C.

Table 8.12
SCREENLINE ANALYSIS SUMMARY

Screenline	Screenline Volume	Capacity	V/C	LOS Standard V/C
5.16 – Ship Canal, University and Montlake Bridges				
Northbound	4,036	4,210	0.96	1.20
Southbound	4,519	4,210	1.07	1.20
13.13 – East of I-5, NE Pacific Street to NE Ravenna Boulevard				
Eastbound	3,655	6,119	0.60	1.00
Westbound	3,900	6,119	0.64	1.00

Source: NACTO, Seattle Comprehensive Plan Update EIS, and Transpo Group, 2016

As shown in Table 8.12, all Alternative 4 screenline V/C ratios would meet the acceptable LOS standard.

8.5.5 Service/Freight Routes

Campus-wide, the overall freight/service-related activities with Alternative 4 are anticipated to be similar to that planned for Alternative 1 as the total development area for each is the same. Increase in volume would shift based on the allocation of development area. With Alternative 4, comparative increases in campus development-related freight and service activity would occur mostly in the East campus sector, accessed off Montlake Boulevard. Therefore, no significant impact due to added freight traffic associated with Alternative 4 was identified.

8.5.6 Parking

Parking Supply

Similar the other development alternatives, it was assumed that parking supply would be increased or decreased within each campus sector to achieve an 85-percent utilization without exceeding the Alternative 4 parking cap of 10,420 spaces. The location of parking and strategies used to maintain the existing City University Agreement (CUA) parking cap would be consistent with those outlined for Alternative 1.

Parking Demand

Overall parking demand for Alternative 4 would be the same as the other development alternatives. Alternative 4 on-campus parking demand and utilization was reviewed by sector to provide context on where parking demand would occur (see Table 8.13). Allocation of Alternative 4 parking demand by sector was based on projected development as documented in Appendix B: Methods and Assumptions. This evaluation assumed that on-street parking would be allocated to on-campus facilities given the increases and reallocation of parking supply to achieve an 85-percent utilization.

Table 8.13
PEAK PARKING DEMAND BY SECTOR

Sector	Parking Supply Cap	Parking Demand			% Utilization
			Alternative 4		
		No Action[1]	Growth[2]	Total	
West	2,820	1,428	969	2,397	85%
South	1,470	1,187	65	1,252	85%
Central	3,580	2,689	355	3,044	85%
East	2,370	1,464	549	2,013	85%
Total	**10,240**	**6,768**	**1,938**	**8,706**	**85%**

Source: Transpo Group, 2016

1. On-campus parking demand for the No Action Alternative is based on a projected increase in population. This does not include on-street parking demand increases noted in the previous table since these would not be parking within the campus sectors.
2. Growth in parking demand is based on a projected increase in population for Alternative 4. The analysis assumes with the street vacation and reallocation of parking supply in Alternative 4, on-street parking demand would shift to on-campus parking.

As shown in Table 8.13, reallocation of parking would result in a parking supply under the existing cap and an 85-percent utilization by campus sector and for the campus as a whole. The additional parking and reallocation of parking supply would provide a better relationship between localized supply and demand and thus reduce the likelihood of parking beyond the University of Washington facilities (i.e., within the neighborhoods).

Secondary Parking Impacts

Parking outside the primary impact zone would likely continue with Alternative 4 similar to the No Action Alternative. This would include people parking their vehicles in unrestricted spaces and then using transit to travel to campus. With future campus growth, this could occur at higher levels compared to the No Action Alternative.

8.6 AERIAL/STREET VACATIONS

Alternative 4 impacts for the street vacation would be consistent with those described for Alternative 1 (Chapter 5). As noted in the Alternative 1 analysis, the City of Seattle has defined polices related to assessing and approving the vacation of public rights-of-way. Further analysis would be provided to the City consistent with the policy requirements at such time an application for a street vacation is made. The EIS alternatives and supporting analysis reflect the vacation as proposed.

8.7 VEHICLE TRIP CAPS

CUA vehicle trip caps are considered campus-wide and would not materially change between the development alternatives. See the related discussion in Chapter 5, Impacts of Alternative 1.

9 MITIGATION

This mitigation chapter identifies mitigation to address impacts identified for each alternative. Mitigation is considered for all modes.

By 2028, any of the development alternatives would accommodate up to 6 million net gross square footage (gsf) of new development at the University of Washington, in addition to anticipated development that would occur under the No Action Alternative (211,000 gsf). This new development would include improvements such as new and wider sidewalks and bikeways, bicycle lockers, and loading areas as well as replacement parking. Table 9.1 summarizes improvements by campus sector and travel mode with the development alternatives.

Table 9.1
SUMMARY OF PROPOSED PEDESTRIAN, BICYCLE, TRANSIT, AND VEHICLULAR IMPROVEMENTS BY CAMPUS SECTOR

West Campus	South Campus	East Campus
Pedestrian		
• Mid-block connections south of Gould Hall • Walkways adjacent to West Campus Green • Improvements along NE Campus Parkway • Mid-block connector east from West Campus Green	• Connection between Central Campus and waterfront along East Campus lawn • Connection along Continuous Waterfront Trail and Waterfront green	• Improved pedestrian network
Bicycle		
• Connection between West Campus Park and Burke-Gilman Trail • Improved bicycle parking facilities	• Improved bicycle parking facilities	• Improved bicycle parking facilities • Improved bicycle network and Burke-Gilman Trail access
Transit		
• Expanded transit stops	• Expanded transit stops	• No proposed improvements
Vehicular		
• Removal of University of Washington NE Cowlitz Road • Extensions of 11th and 12th avenues NE	• New or consolidated signal for garage access along NE Pacific Street • Removal of University of Washington NE San Juan Road • New University of Washington roadway connections between NE Columbia Road/NE Pacific Street • Enhanced access for Marine Sciences from NE Columbia Road	• No proposed improvements

9.1 TRANSPORTATION MANAGEMENT PLAN

As described in Chapter 1 of this report, the University has successfully maintained traffic levels that fall well below the agreed-upon traffic and parking caps, which hold University of Washington traffic and parking impacts at and below 1990 levels. The University has accomplished this, despite a campus population that has grown by more than 35 percent since 1990, by successfully reducing the percentage of student, faculty, and staff commuters who choose to drive alone as their commute mode. Implementation of the University's transportation management plan (TMP), within which the U-PASS program exists, has been the means through which all primary and supporting strategies have been implemented. The Transportation Management Plan is included as a chapter within the CMP and describes updated strategies that the University will apply to meet these three goals:

- Limit the proportion of drive-alone trips of students, staff and faculty, to and from the campus to 15% by 2028.
- To reinforce the University's commitment to limiting auto travel, the University will continue to cap the number of parking stalls available to commuters within the Major Institution Overlay boundary to 12,300. This parking cap has remained unchanged since 1984.

The TMP describes monitoring including annual surveys to assess these goals. As noted in the TMP within the CMP, strategies to meet these goals are described within 8 programmatic areas.

1. U-PASS Program
2. Transit
3. Shared-Use Transportation
4. Parking Management
5. Bicycle
6. Pedestrian
7. Marketing and Education
8. Institutional Policies

Transportation Management Plan (TMP): The University's transportation management plan that provides strategies for limiting traffic impacts and promoting active communities by managing vehicle trips and parking, and accommodating transit and non-motorized travel modes.

A history of the caps and how they are calculated is included in the Appendix B Methods and Assumptions As described briefly in Chapter 1 and in greater detail in Chapter 3, the University has been successful at meeting the TMP goals and has not exceeded these goals even though the University has grown. It is notable that the University is committing to a drive alone goal of 15% by 2028, which is lower than the 20% drive alone rate conservatively assumed for this analysis. If this is achieved, actual impacts associated with the proposed campus development would be less than described for the development alternatives in Chapters 5 through 8 of this report.

The University will continue to mitigate transportation impacts through implementation of their TMP to ensure that 1990 levels of impact are not exceeded, despite ongoing growth. Specific strategies will continue to be refined annually, subsequent to the annual transportation survey and publication of the CMP annual monitoring reports. The TMP also includes ongoing coordination with agency partners through a quarterly transit Stakeholders committee meeting.

The Link light rail University of Washington Station at Husky Stadium is already resulting in substantial changes in the way commuters and visitors access campus. Additionally, anticipated extensions of Link light rail to Northgate in 2021 and to Lynnwood, Redmond, and Federal Way in 2024 will improve the opportunities and access to transit for University students, faculty, staff, and visitors.

9.2 PEDESTRIAN OPERATIONS

As described in Chapters 5-8 facilities for pedestrians will be adequate to meet the needs of a growing Campus. Potential impacts may occur at bus transit stops which may require expansion to meet a comfortable waiting space. Space is available to make these adjustments within the University right of way.

9.3 TRANSIT OPERATIONS

As described in Chapter 4 increased anticipated transit service including extensions of light rail and new RapidRide will encourage transit use for students, faculty, and staff. Chapter 5 describes impacts to transit for all development alternatives and as noted, transit service may be slowed in some corridors due to background and campus increased transit travel. Potential mitigation includes accommodating all door boarding to reduce delays caused by boarding. This can be done with off-board fare payment that is part of RapidRide systems. Additionally, improvements in transit speed and reliability including strategies like queue jumps and exclusive bus lanes can further enhance transit operations.

9.4 INTERSECTION OPERATIONS

Improving overall intersection operations through Intelligent Transportation Systems (ITS) consistent with the City ITS Next Generation plan could enhance and improve overall traffic operations, particularly during peak periods. The University supports implementation of ITS system enhancements in the University District. Other specific mitigation measures were considered for the signal-controlled intersections anticipated to operate at LOS E or F and experience a 5 second or greater increase in delay with any of the development alternatives.

29. Montlake Boulevard NE/Mary Gates Memorial Drive NE (signalized)
32. 11th Avenue NE/NE 43rd Street (signalized)
67. 15th Avenue NE/NE Pacific Street (signalized)

With limitations in right-of-way at current signal-controlled intersections, potential mitigation measures could include modifications to signal timing, such as phasing, offsets, and cycle length. While such modifications could decrease delay at these intersections, they wouldn’t decrease the delay to at or near forecasted the No Action Alternative conditions.

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10 SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Development of the University of Washington to a Campus Master Plan (CMP) maximum with 6 million net new gross square footage by the year 2028 will result in increases of trips in all travel modes—pedestrian, bicycle, transit, vehicle, and freight. While the University has been extremely successful at reducing overall single driver travel through their Transportation Management Plan (TMP), overall, the level of growth identified in this 10-year planning horizon (2018–2028) could have significant impacts on pedestrian conflicts. Specifically, such conflicts could occur at new Link light rail stations and local arterial crossings, for parking within the University District (U District), and with overcrowding on transit. In addition to the University of Washington, local agency partners like the City of Seattle, King County Metro, and Sound Transit have plans to increase transportation facilities and services. These plans include expanding the Burke-Gilman Trail, completing pedestrian and bicycle networks, and expanding the frequency, capacity, and travel time of transit. The University will be working to enhance connectivity and circulation with each development. Lastly, the University of Washington, through their City-University Agreement (CUA), continues to annually monitor parking and trips. The University also conducts annual surveys of mode splits.

With access to light rail at the University of Washington Station that opened in March 2016, the campus is already seeing a significant (roughly 13 percent) increase in transit ridership. With the opening of another light rail station serving the U District, scheduled for 2021, access to expanded RapidRide and new regional trail connections across Montlake will give students, faculty, staff, and visitors more reliable transportation alternatives to driving alone. Also, with planned construction of affordable and multifamily housing nearby, drive alone trips may continue to decline as students, faculty, and staff will have more choices for living near campus.

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APPENDIX E

Residential Location and Transit Access to Campus

Appendix E: Residential Location and Transit Access to Campus

Access to campus will change over time as urban neighborhoods become more congested and as transportation infrastructure is improved. It is worth examining more closely transit access to campus since major transit investments have been recently completed or will be completed during the period covered by the 2018 Seattle Campus Master Plan.

Sound Transit's University of Washington Station at Husky Stadium opened in 2016, connecting the campus with Capitol Hill, Downtown Seattle and the initial Link service continuing south through the Rainier Valley to SeaTac airport. This service represents improved transit travel times to campus from many existing communities (many with apartment rents that are below those in the Primary and Secondary Impact Zones) than would not be evident in the historic residential location choices represented by current student, faculty and staff home locations. In 2021, the Northgate Link extension will open for service and will include new Link stations in the U District, Roosevelt and Northgate and to Lynwood in 2023. This transit connection to communities north of campus will represent a significant transit travel time improvement to campus from neighborhoods with a variety of housing options.

With information about relative prices for housing and relative access to campus by transit from various Seattle neighborhoods, a simple analytical model was developed that explains shares of future student residential locations by zip codes as a function of these factors. As transit access to campus is improved in the near future (and the very recent past) it is anticipated that shares of students choosing to live in neighborhoods with improved transit access will increase.

The model estimated shares of students by zip code as a log-odds function of average rent values, distance to campus, distance squared, and transit travel times to campus. The model explains 73 percent of the variability in the share of students by zip code from the estimation data.

Model data was assembled from housing inventory data reported throughout this report from CoStar and King County Assessors records. Existing transit trip time estimates are based on the application of Google transit trip planning tools for an AM peak period trip between origins and the UW campus. Along with expected LINK station to station travel times provided by Sound Transit and reproduced in the Seattle Transit Blog http://stb-wp.s3.amazonaws.com/wp-content/uploads/2015/08/10143005/Screen-Shot-2015-08-09-at-9.07.39-PM.png

Table A1-1
Model Results Table

R	0.89353
R-square	0.79839
Adjusted R-sq	0.72508
S	0.7109
N	16

tobit = 3.45296 - 0.00163 * rent + 6.36783E-6 * dist^2 - 0.01062 * dist - 0.00387 * timecost

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	4.	22.01496	5.50374	10.89044	0.00081
Residual	11.	5.55911	0.50537		
Total	15.	27.57407			

	Coefficient	*Standard Erroi*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%)*
Intercept	3.45296	1.31139	0.56662	6.3393	2.63306	0.02328	*rejected*
rent	-0.00163	0.0006	-0.00294	-0.00032	-2.73599	0.01937	*rejected*
dist^2	6.36783E-6	1.20393E-6	3.718E-6	9.01766E-6	5.28921	0.00026	*rejected*
dist	-0.01062	0.0021	-0.01523	-0.00601	-5.06782	0.00036	*rejected*
timecost	-0.00387	0.0037	-0.01202	0.00428	-1.04614	0.31794	*accepted*
T (5%)	2.20099						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Source: ECONorthwest

The model coefficients were then applied to estimates of transit travel times to campus given current Link service to UW campus and expected transit times once the Northgate Link extension is operational. When considering both housing costs and transit travel time to campus, it is clear that the future distribution of students by Seattle neighborhood may somewhat shift away from the immediate neighborhoods close to campus. Future shares of student residential locations by zipcode can then be applied to the estimated total number of future students not living on-campus to better understand the possible housing demands in various close-in neighborhoods.